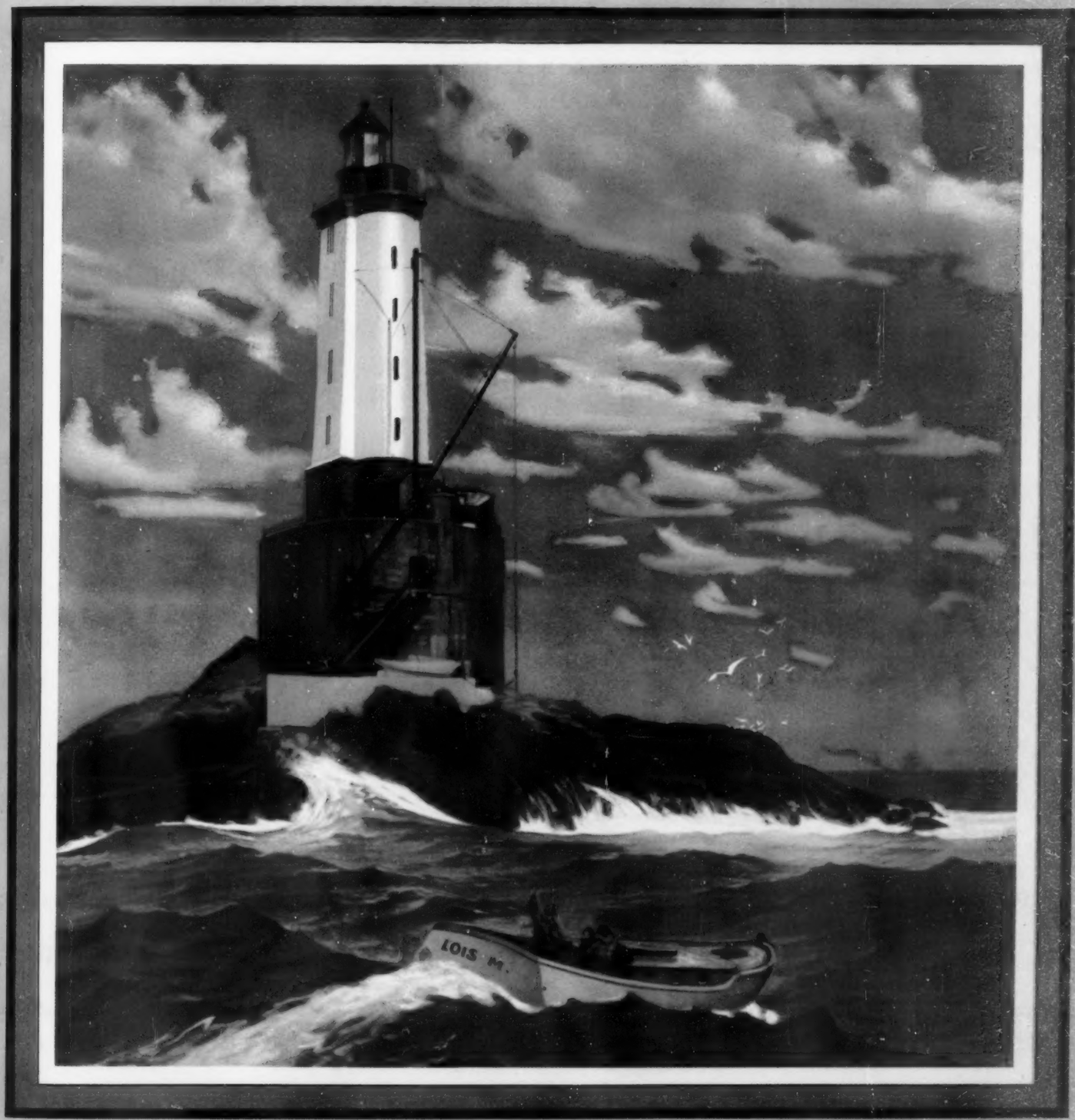
SCIENTIFIC AMERICAN

ARE WE OVER THE POLE?

By Nell Ray Clarke

A TWENTY-FIVE FOOT EYE

WHAT LOWERED THE GREAT LAKES?



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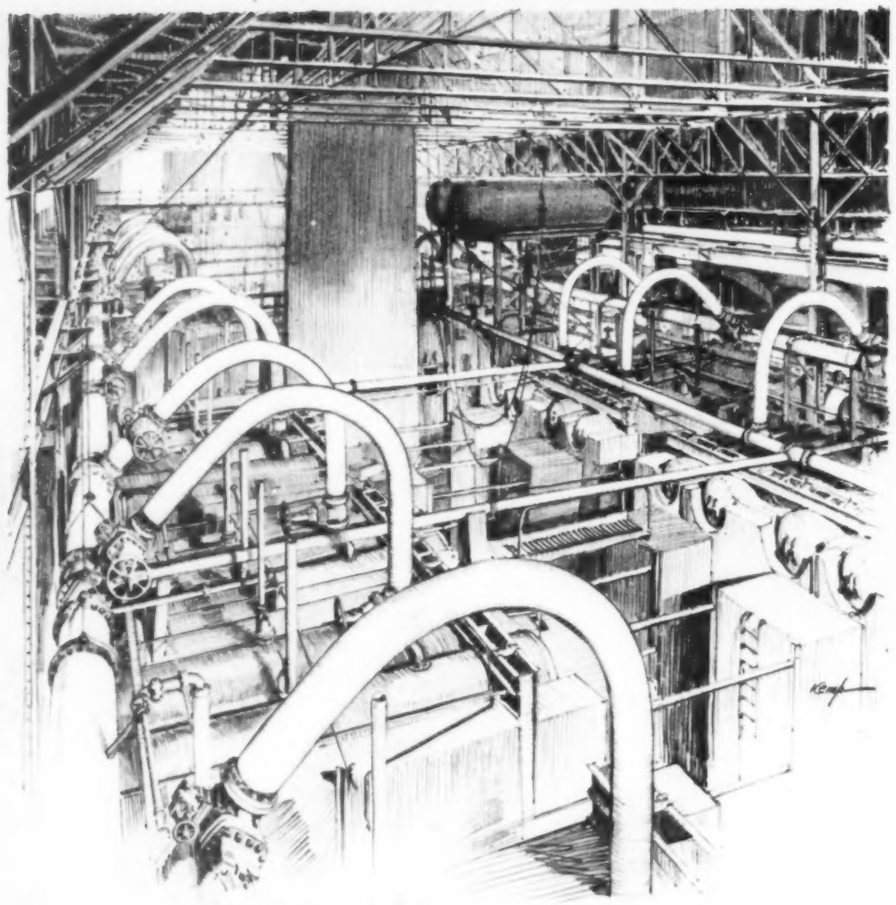

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One brief, laconic sentence in a letter from The Atlas Portland Cement Company tells the story of the service given by Crane valves, fittings, and piping. "This material," it says, "was purchased from Crane Co. in 1904 and is still operating as originally installed."

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A Crane mixing valve to temper and control your morning shower.

Above: a view in the boiler house of Plant No. 4, Northampton, Pennsylvania, of The Atlas Portland Cement Company, makers of Atlas Gray and Atlas White Portland Cement. The Crane piping materials illustrated are now twenty-two years old, and are still operating as originally installed by the Atlas power department.

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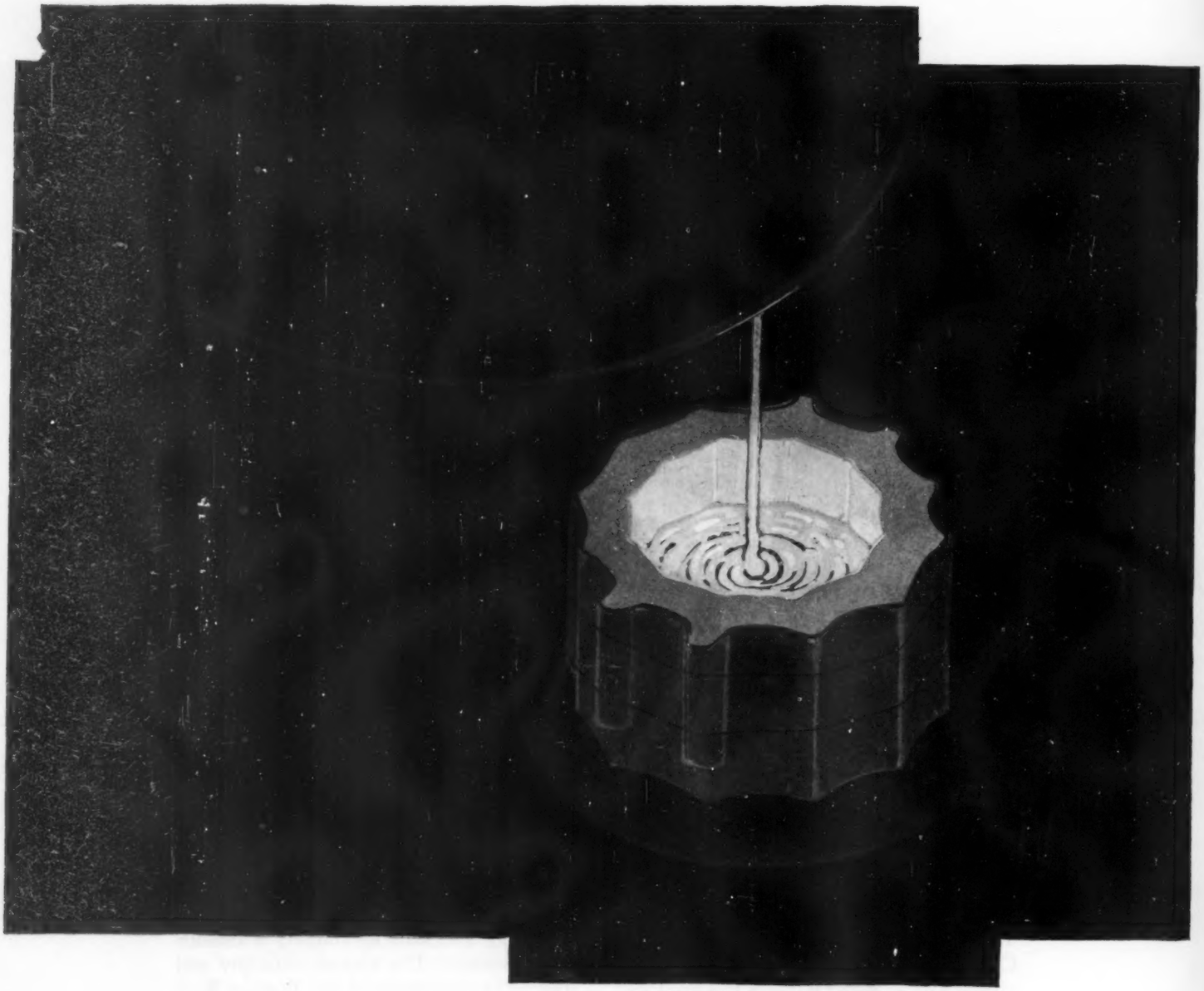

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SCIENTIFIC AMERICAN

THE MAGAZINE OF TODAY AND TOMORROW

NEW YORK, SEPTEMBER, 1926 *Edited by* ORSON D. MUNN EIGHTY-SECOND YEAR

EVOLUTION

TENNESSEE forbids the teaching of evolution in state-supported schools. The Florida House of Representatives passes a resolution having similar aspirations. Kentucky barely defeats an anti-evolution bill; another is threatened. In North Carolina the High School Textbook Committee removes two school books from the list—they contained matter on evolution. In Louisiana an anti-evolution bill passes the lower House, but the Senate postpones the issue. And now comes Texas, whose State Textbook Commission draws a black line through every mention of the word evolution in biologies, substituting therefor the word "development," thus beating the devil around the stump. What next?

They say that in these states people who never before heard of evolution are inquiring into it, finding it interesting. Boys, denied the forbidden subject at school, furtively read about evolution from booklegged treatises, down behind the barn, where their fathers once read "Pluck and Luck," "Fred Fearnot" and "Diamond Dick," the while smoking cigarettes concocted of cornsilk.

To forbid is to recommend. These state legislatures are doing a great work for evolution.

SUBWAYS

ROME is to have a subway. That ancient city, beneath whose streets rest thousands of historical relics, is to be modernized to the extent of having what New Yorkers refer to as "sardine cans on wheels." The present plan is to build seven lines with a total mileage of twenty-two, the constructional work to cover a period of ten years. It is expected that the necessary excavations will bring to light priceless records of ancient civilization. In order to preserve these, archaeologists will cooperate with the construction engineers during the work and will carefully save as many of the relics as possible.

MOSQUITOES

SOME of us have been worried about the Grand Canyon. We heard rumors that it was rapidly being filled up with tomato cans thrown into it by tourists.

We shall worry no longer. The United States Public Health Service has found a way out. H. B. Hommon, sanitary engineer of the Service, has devised a can crusher. This he recommends especially for use in national parks where empty food cans strewn about constitute a serious problem. Not only are tin cans unsightly, but when it rains they become partly filled with water and breed mosquitoes.

In This Issue

Who Built the First House?

Nobody knows, but a noted British archeologist has discovered parts of a house that may be 100,000 years old—longer than modern houses last! See page 170 for the account of this remarkable find.

How Did Byrd Find the Pole?

When Byrd flew northwards over the trackless ice-floes, he knew exactly where he was "at" every minute. This appears to have mystified many people. The apparatus that he used was simple, the methods equally so. On page 188 they are lucidly explained.

A Brobdignagian Telescope

Astronomers have planned a telescope beside which the largest now in existence is but a dwarf. It will cost a fortune. What will it reveal? Page 174.

Is Cousin-marriage Injurious?

Yes, says tradition hoary with age. Many states forbid it by law. Now comes the modern science of genetics, accepting nothing, testing all things, and says cousin marriage is not necessarily injurious. For a famous example, see the narrative on page 182.

What Happens?

When things go wrong, what happens to a high-voltage transmission line? Surges of terrific voltage, interruption of power, trouble—these happen. How to eliminate these damaging surges—this was a recent problem. It has been solved. Page 176.

MORE THAN 200 PICTURES

Complete table of contents will be found on page 240.

For Next Month

Cold Light—What Is It?

When man makes artificial light he wastes most of the power producing heat. Deep-sea fishes have far more efficient light-plants than man—when they make light they make light alone. Next month, Dr. David Starr Jordan, world famous scientist, will explain these fish.

The Wonders of the Commonplace

Most of us take Nature and science too much for granted. Yet there are "sermons in trees and food in everything." We miss many marvels simply because they are so commonplace. Next month a noted government scientist, Dr. Paul R. Heyl, will point out for you some of these wonders.

Marconi Was Right!

Beam radio and short waves have "come in," decidedly. They have come even more quickly than Marconi predicted less than five years ago, thanks to the amateur. In our next issue Mr. Dunlap will explain some of the marvels of short-wave transmission and reception.

Other articles on Ancient Ice Ages; The Japanese Beetle; Hay Fever; The Chicago Drainage Canal; New Developments in Automobile Engines; The Peabody Museum; Domestic Oil Heating; Conservation; Astronomy; Radio.

MORE THAN 200 PICTURES

MYTHS

THERE is no such thing as a "wet moon" or a "dry moon," the Weather Bureau finds it necessary to remind the public. The moon has nothing to do with rain, and the old saying that the moon portends wet weather because it tips like a pitcher pouring out water, or that dry weather is due because the tips of the crescent are tilted upward, is nonsense.

Why? Viewed from near the earth's equator the young moon never makes an angle of more than 30 degrees with the horizontal and it is generally more nearly horizontal, or "dry," than this. Yet are the tropics dry? And at the earth's poles a line drawn through the horns of the moon's crescent is always within 25 degrees of vertical—"wet" moon! Yet the polar regions are really among the more arid regions of the globe.

Brushing aside this age-old myth is only a little thing, but it illustrates perfectly the job of science—to replace superstition with knowledge.

SAFETY

THE non-explosive quality of the helium gas with which our airships are filled, is, of course, a great protection. But although there is no danger from the gas which lifts the dirigible, there is danger from the gas which drives it. The hazard from fires and explosions of gasoline vapors in any rigid airship is very real, and although every possible precaution is taken, the mere presence of tons of gasoline aboard a ship constitutes an ever-present threat. Hence, the Navy has turned its attention to the heavy oil engine, and it is gratifying to learn from the Secretary of the Navy that preliminary tests of experimental oil engines now under development by the navy have proved satisfactory.

CHECKMATE

OUR British contemporary, *English Mechanics*, states that the Duke of Bridgewater, when in charge of an important engineering job, noted that his workmen frequently failed to return to work when, after the dinner hour, the clock bell struck one. As an excuse they told the duke that they had failed to notice the single stroke.

So the duke "went them one better." He had the clock altered so that at one o'clock it struck thirteen! Nobody could say he had failed to notice *that*.

Our suggestion would have been, to make the clock strike once at twelve o'clock, and twelve times at one o'clock. We feel sure that not a man would fail to hear the single stroke at quitting time.

Dr. Alexis Carrel, Noted French Scientist of the Rockefeller Institute

Few men have conferred greater aid to mankind than Dr. Carrel. Born in France in 1873, after several years of service in Lyons as an interne, he came to America in 1905. Four years later, Dr. Carrel became a member of the famed Rockefeller Institute for Medical Research in New York. In 1912, he was honored with the Nobel Prize, for his remarkable work in suturing blood vessels and the transplantation of human organs. When the World War came, he dedicated his services to his native France, serving through four years of the great struggle and working out a method of applying Dakin's Solution to wounds, which quickly reduced the average of mortality from high to extremely low. The Carrel method is remarkably simple. The wound is repeatedly irrigated with Dakin's Solution—a hypochlorite of soda, costing only a cent a quart. Through rubber tubes, it reaches all parts of the wound, maintaining a continuous action of the antiseptic. Infection is suppressed, the wound is sterilized and the patient's chances of recovery are increased many times. Since the war.

Dr. Carrel has remained attached to the Rockefeller Institute, engaged in new researches.

The Entrance to the Gennadeion

This exquisite example of architecture recalls the carvings of the north doorway of the Erechtheion. The Ionic columns of the main façade, two of which are shown, are each composed of three circular blocks or drums of Pentelic marble, each being two feet, eight inches in diameter and seven feet high. These heavy blocks of the fine stone were hauled down the mountain side by hand power, being placed on skids for this purpose.

American Building Methods in Greece

How the Gennadeion, Library of the American School of Classical Studies at Athens, Was Built in Two Years and Two Months

By Gladys Thompson

IN 1922, Dr. and Mme. Johannes Gennadius decided to present their magnificent collection of books, known as the Gennadius Library, to the American School of Classical Studies at Athens. The gift was a great one, for the collection comprises between 45,000 and 50,000 items relating to Greece—ancient, Byzantine, and modern, as well as many first editions and 800 rare and unique bindings. The Carnegie Corporation gave the money for a fitting and worthy building to house this collection which, although the property of the American School of Classical Studies, is to be accessible to scholars of all nations. The firm of Van Pelt and Thompson of New York City was commissioned to design and erect the building by the committee of which Dr. Edward Capps of Princeton University was chairman.

The library, called the Gennadeion in memory of the father of Dr. Gennadius, is a simple rectangle in form with a façade of eight Ionic columns of the Erechtheion type, a decorated cornice, and a large inscription in Greek on the frieze which announces that all who share in Greek culture are Greeks. Extending at right angles to the library and forming a mammoth forecourt are residence buildings for the librarian and the annual professor. These residences are connected with the library by colonnades of twelve marble columns. All the exterior of the building is made of marble, except a Piraeus stone foundation, and, although the building stands in Greece, the home of the most famous marble quarries in the world, it was marble that was the most difficult material to get for the building.

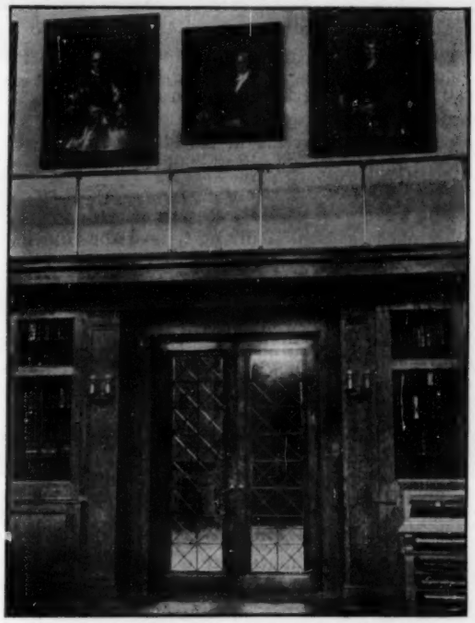
Labor for 35 Cents a Day

Mr. W. Stuart Thompson arrived in Athens in April, 1923, to let the marble contracts himself. He estimated that about 1,000 tons or about 500 cubic meters of marble would be needed for the building. Mount Pentelicus, so often thought of as that inexhaustible supply of beautiful white marble of the Athenian Acropolis, seemed the natural source for the bulk of the Gennadeion marble. It lies only eleven miles to the northeast. Visits to the various quarries on Pentelicus were most interesting but disappointing to one seeking more than a few window sills and first story blocks for a private residence. Actually there is very little available of the far-famed beautiful white marble. The ancient quarries are very deep, and, in inspecting modern openings in other places on the mountain side, one marvels at the labor and expense which were evidently necessary to obtain marble comparable to that on the Athenian Acropolis.

Ordinarily, in speaking of Pentelic marble, one visualizes a beautiful clear white stone of excellent quality which, after long weathering by time, gradually takes on a gorgeous yellowish tint due to the iron in its composition. Actually this quality is obtained only by cutting out great strata of marble which vary in color from a light gray to a coarse blue slate. It also runs spotty in color. Upon careful inspection of the most promising Pentelic quarry it was estimated that it would take a minimum of five years to quarry the desired cubage and that the expense would be far too great. Hymettos, famous in ancient times for its marble, lying to the east of Athens, had nothing at all to offer. So the historic quarries of the Greek mainland and islands were canvassed.

Naxos, the largest of the Cyclades, in the Aegean Sea, 110 miles from Athens, had quarries where the desired cubage of a good quality white marble could be obtained in about fourteen months. It was from here that the bulk of the marble came for the Gennadeion, and it is interesting to note that in an ancient Naxian quarry, not worked today, there still lies *in situ* an unfinished colossal statue of Apollo.

Actual construction was started on September 1, 1923. Mr. Thompson, a former Fellow in Architecture in the American School and a lover of Greece, settled down to supervise the work. As no contract could be let in Athens due to the tremendous fluctuation in the drachma, the Greek unit of money, and



SOUTH WALL OF READING ROOM

On the wall over the doorway in the above illustration are the portraits of Dr. Johannes Gennadius, Dr. George Gennadius and Mme. Johannes Gennadius

the great instability of all kinds of business caused by the Smyrna disaster and the enormous influx of refugees, the labor market of Athens was drawn upon and ten refugees were hired to start excavating the foundations. The news spread through Athens that work could be had at the Gennadeion, and the next morning there were hundreds of men and boys swarming over the locality. It was necessary at once to build a barb-wire fence around the property to keep out the labor which could not be used.

During the excavating, common labor was hired for three day periods only, so that work could be given to as many as possible. These men were newly arrived refugees, and although Greek nationals, could often speak only Turkish. They fought to work for 35 cents a day. Earnest expressions of gratitude were sent to Professor Capps of Princeton, Chairman of the Managing Committee of the American School, and to the Carnegie Corporation for work already given and the work to come.

Unskilled labor was begging for work but first-class, trained workmen were nearly impossible to find. Carrying out definite instructions, even of the simplest, is something a Greek laborer cannot be depended upon to do. He prefers trying some other way, or, if he has the opportunity, several ways. With this natural propensity, plus a lack of training, it was necessary to check over most carefully everything delegated to anyone to do. Gradually a nucleus of trusty men was formed. They were refugees and for the most part lived on the job.

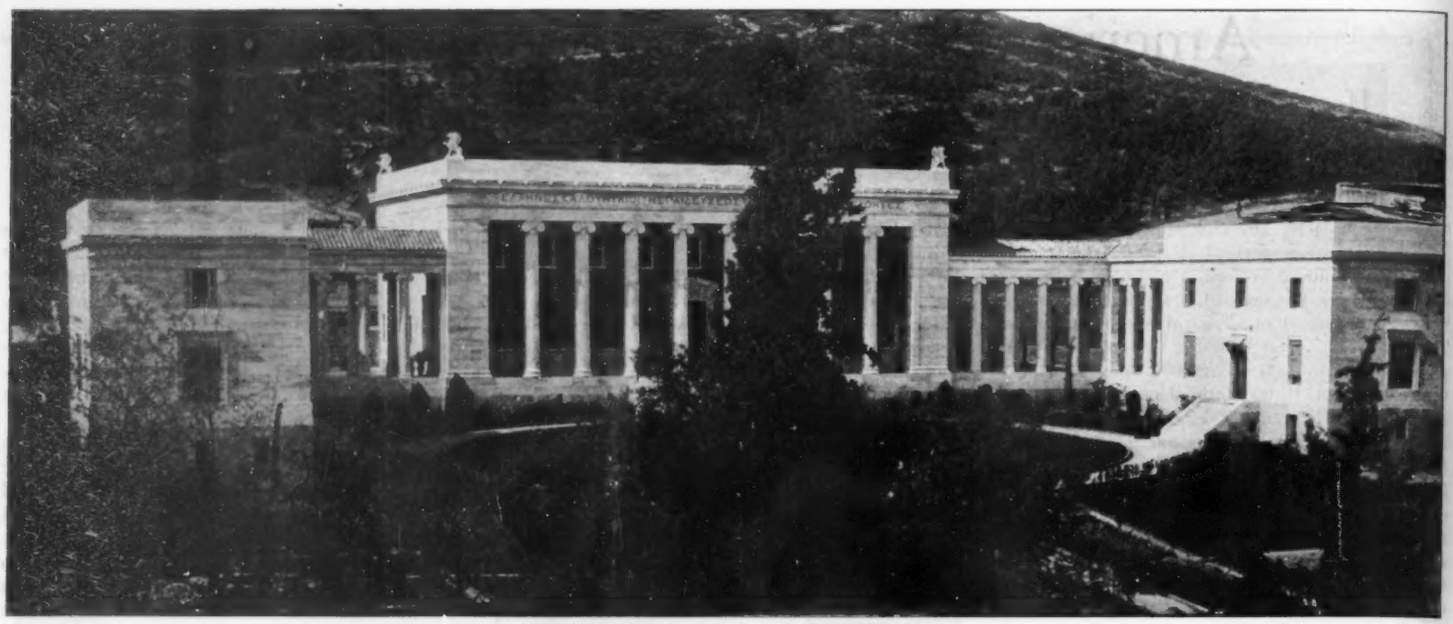
All marble was delivered in rough blocks as quarried. It was cut, polished, and rubbed down by hand on the building site. The methods and tools in use were the same as used by Iktinos and Kallikrates, the architects of the Parthenon. It took 99 working days for an expert marble cutter to finish one of the capitals for the main façade. Such a worker allowed for the variations in resistance caused by the differences in grain of the marble. In this connection it is interesting to note that there is only one hand-cut marble building in America, and that is the Morgan Library.

The marble was set under the supervision of an American stone setter who used modern derricks. These derricks were a great delight to the workmen. It was necessary to watch them constantly to keep them from playing with the derricks to see how they worked. As marble foreman, the man was engaged who had been in charge of the repairs on the Acropolis. Gradually a force of expert marble cutters, collected in Constantinople, the interior of Asia Minor, and the Greek Islands, was concentrated at the Gennadeion. With them they had all their worldly possessions of a few rags. In skill they far surpassed any marble cutters that could be found in America.

All Work Done on Site

The Gennadeion was now a very interesting place as all work usually done in shops or factories in America was done on the site. Small shops were run; all the ornamental iron was forged; necessary woodwork was finished and every piece of marble was cut and polished in much the same way as buildings were built hundreds of years ago. Workmen in Greece still belong to guilds, and the trade is handed down from father to son. In the marble shed there were three generations of marble cutters.

The Athenian architects and engineers were much interested in American methods of working and visited the building often. The Professor in Engineering in the University brought his classes there regularly to inspect the different method of building with stone setting derricks from the interior of the building and without exterior scaffolding. The proper mixing of concrete and the pouring of floor panels caused much interest. The concentration of one man on a particular job instead of dropping his work to get new materials, as is the accepted procedure in Athens, caused much comment. The fact that all plumbing, steam fittings and electric wires were concealed before the building was plastered was an exciting novelty. In Greece a building is completely plastered before plumbers, steam fitters and electricians are called to do their work. They then cut holes in the finished walls and floors and leave exposed most of the pipe and wire. An experienced plumber was brought from America, paid 16 dollars per day plus board and traveling



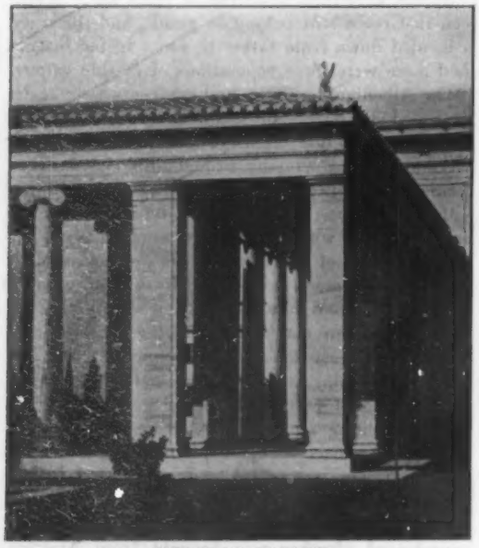
THE GENNADEION IN ITS COMPLETED FORM

This view shows the magnificent structure silhouetted against Lycabettus, as seen from the roof of the American School of Classical Studies

expenses, and still fifty percent was saved over the estimates given by local firms.

It was not possible to purchase in Greece the materials for the interior finish. These materials were quite international in origin; bronze grilles and doors, woodwork, steel, plumbing and heating materials came from the United States, glass from Belgium, fabrics from France, steel bookcases from England, while all furniture was especially made in Budapest and Vienna.

These imported materials were easy to get. It was the lack of marble that constantly caused concern and delay. Naxian marble could only be loaded on caiques when there was a south wind. Sometimes contrary winds held back the marble for two weeks or more. Then, again, owing to the stratification of the marble, cornice blocks were cut when blocks were urgently needed for the lower courses. Three special trips were made to the quarries to expedite the shipping of marble. Due to the precipitous and inaccessible mountain passes, days were needed to make the trip. Traveling in a little boat, the Aegean Sea is no more dependable now than in the days of Homer. On one of these excursions the boat was becalmed for sixteen hours and on another its occupants were nearly drowned in a terrific storm. To speed up the quarrying of marble, men were employed running in three daily shifts of eight hours each.



THE EAST ARCADE

This connects the main building with one of the residences

The Library of the University in Athens, the only other modern marble building comparable with the Gennadius group in size, took sixteen years to build; the Gennadeion, with the exception of the fluting of the main columns, two years and two months.

The twenty-four columns of the two side arcades are monoliths. Each one is eighteen feet high, has a diameter of one foot, six inches and weighs about three tons. The heaviest single pieces of marble are the two lintels, one being over each balcony in the two residences in the Gennadius group. Each lintel weighs four and one-quarter tons, is fifteen feet six inches long and two feet high.

Marble of Various Colors Used

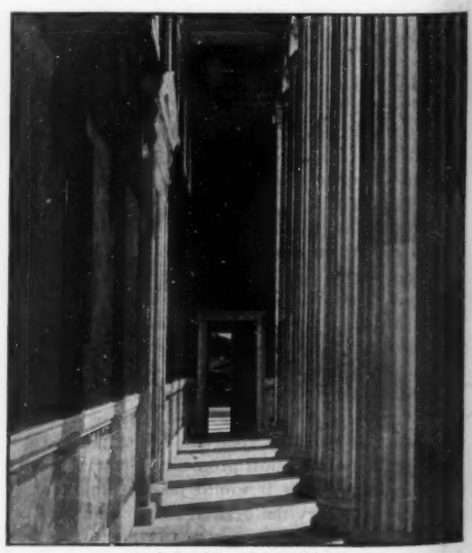
The unexpected appearance of a blue stratum in the Naxos quarry prevented the main columns coming from there. A new opening on Pentelicus gave a marble of exactly the same quality in color and texture. The entire output of this quarry, representing fourteen months' labor, was used to supply the necessary eight columns for the main façade. Each column consists of three drums, the drums being two feet eight inches in diameter and seven feet high. The heavy blocks of marble were brought down the steep mountain side on skids by hand. It took eleven days to cover the eleven miles.

Skyros marble in many varieties of color and veining have been used in the Gennadeion for decorative purposes. In two contrasting colors it makes a beautiful wainscot for the chief façade. In the vestibule of the library, six variations of this exquisite marble are employed, ranging in color from the most beautiful alabaster white to the deep gold and violet veined specimens. Throughout the group of buildings the mantelpieces have been made of the orange-yellow, white and slightly violet-veined Skyros. None of this Skyros marble could be bought in the open market in Athens. It was necessary to buy it from an English company which had bought all the available supply of the material for shipment to America.

The ancient Greek color palette composed of the three primary colors, red, blue and yellow, plus a small amount of green and a liberal use of gold as a blending medium, has been used for the decoration of the ceiling of the main colonnade and for the wall decorations of the interior of the building. The addition of color to the exterior has greatly enhanced the beauty and grandeur of the whole group.

The Gennadeion was dedicated on April 23. Dr. and Mme. Gennadius, Dr. Henry S. Pritchett, President of the Carnegie Corporation, and Mrs. Pritchett, Judge William Caleb Loring, President of the Board of Trustees of the American School, Professor Edward Capps, former Minister to Greece and Chairman of the Managing Committee of the American School, and Mrs. Capps, as well as a large representative group of prominent archaeologists and classical scholars and delegates from seventy-five American and foreign universities attended the impressive ceremonies.

The Japanese beetle, an insect pest that is destroying vegetation in the eastern United States, is being fought with other insects. Read about the battle for the preservation of crops in our October issue.



THE MAIN COLONNADE

Looking east between the building and the row of columns

The Haardt and Audouin-Dubreuil, French, trans-African motor expedition stops near the Anglo-Egyptian Sudan to permit its taxidermists to prepare the skins and skulls of animals killed in the bush. With eight cars equipped with endless treads this expedition traversed Africa from Algeria in the northwest to Madagascar in the southeast, reaching that island which, like Algeria, is a French possession, by boat

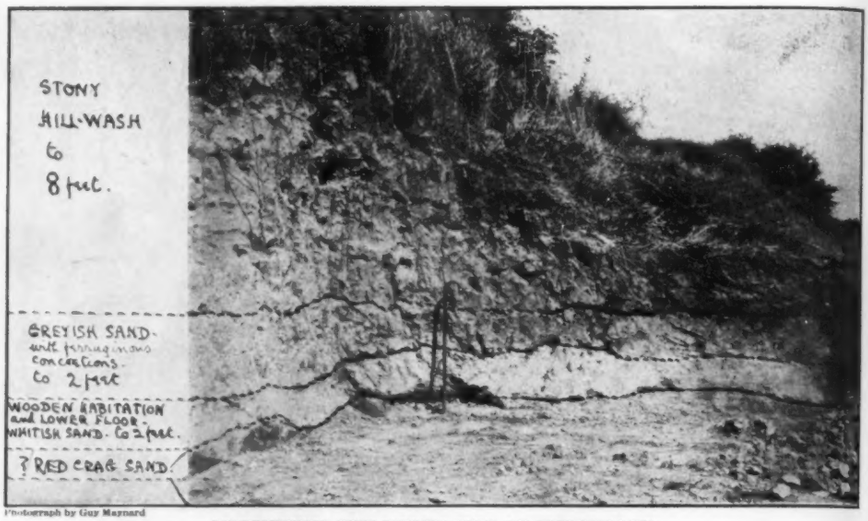
Feet of the rhinoceros, hippopotamus and elephant, considered a great feast by the natives, and converted by the white man into waste paper baskets. During the past two years Africa has been covered with a network of motor traverses, and the "Dark Continent" is rapidly losing its aspect of darkness. Railroads, motor roads and plantations are displacing black man and beast. Those who would see "wild" Africa must hasten

Antelope, buffalo and elephant skulls in the Belgian Congo. Only a small part of Africa is covered with jungle. A large part is open plains, nearly treeless

Photograph by Guy Maynard

REMAINS OF THE WOODEN HABITATION

FIGURE 1: *The planks were held in place by means of stakes*



Photograph by Guy Maynard

UNCOVERING THE NORTH SIDE OF THE VALLEY

FIGURE 2: *The wooden habitation was found in the lower two-foot stratum (See Figure 6)*

Was the Cave Man a House-builder?

The Remains of a Crude Wooden Structure, Probably Built by the Long-extinct Neanderthal Man, Have Recently Been Unearthed in England

By J. Reid Moir

Fellow of the Royal Anthropological Institute of Great Britain and Ireland

ALTHOUGH there has now been discovered in various parts of the world an enormous quantity of prehistoric implements made of flint and other rocks, together with a number of artifacts in bone and ivory, especially the remarkable finds made recently at Predmost, in Moravia, the records of the finding of examples of ancient man's handiwork in wood are by no means so numerous.

We know that wood was used extensively in prehistoric times, in the construction of lake dwellings and similar structures, but the remains of terrestrial dwellings made of wood, and of Stone Age date, are met with but rarely. The reason for this may perhaps be that wood, unless subjected to certain favorable conditions, disintegrates and disappears during the slow passing of the centuries.

It may, therefore, be of some interest to learn that I have recently discovered in the brickfield of Messrs. A. Bolton and Company, Ltd., in the northern portion of Ipswich, in eastern England, the remains of a wooden structure that may be of considerable antiquity.

The Oldest "House" of All

The archaeological diggings, which have been carried out under the auspices of the Percy Sladen Memorial Fund, and by the kind permission of the directors of the brick works, were undertaken in the north-easterly portion of the small, streamline valley in which these works are situated.

Embedded in the deposits which now cloak the sides of this valley, are two superimposed "floors" (Figure 3), or ancient occupation levels, at which a large number of flint implements, flakes, and hammerstones, together with hearths, fragments of coarse pottery, mammalian (including mammoth, and some human bones, comprising fragmentary portions of a femur, humerus and a thick skull) have been found. In fact, from the relics already recovered a more or less complete picture of the hand axes, points, scrapers (Figure 5), and rough pottery made by the robust type of people who inhabited this small Suffolk valley in the remote past can be visualized.

But, the discovery of what appears to be the remains—the basal portion—of one of their dwellings at the level of the lower floor introduces us to an even more intimate and interesting phase of their activities. At the site where these remains have been found there exists a small terrace in the valley, and the recent diggings have shown that the lower floor which rests upon yellow sand continues into the foot of this escarpment and is covered by a series of deposits averaging thirteen feet in thickness. (Figure 2.) The basal yellow sand is present in other parts of the valley, and, wherever it contains water, it has in it numerous roots of trees *(Pinus sylvestris)* that flourished evidently on the ancient land surface represented by the lower floor.

There is little doubt that this sand was dry when these trees, which do not favor wet ground, and are not now found in the valley, were growing, and the preservation of their roots is almost certainly due to the present water-logged condition of the sand which has provided the favorable conditions necessary for the preservation of wood. A quantity of these roots was found in the sand underlying the lower floor at the site of the recent diggings and in close association with the wooden structure here described.

THE TWO OCCUPATION FLOORS

FIGURE 3: *An "occupation floor" is a stratum of soil, formerly on the surface, containing lost or discarded objects*

This structure consists of two pieces of oak of plank-like form, which overlap where they meet, and were placed with one of their longer edges buried superficially in, and more or less vertical to, the surface of the underlying sand. (Figure 1.)

The "planks" are about two feet long, eight inches wide, and one inch in thickness and, by their characteristic form, were evidently split off a trunk of large size. Behind these planks, which may perhaps be likened to modern "base boards," were piled a quantity of flints, and other fairly large stones. Beyond these, to hold the whole thing in position, is a row of stakes not closely set together, roughly pointed and driven into the sand to a depth of about one foot. These stakes have most of their upper portions missing, and were not inserted vertically, but inclined at an angle of about 45 degrees to the east.

An Ancient Manufactory

Between the planks and the supporting mass of stones, were found traces of clay in which were partially embedded portions of numerous branches. It is supposed that these branches, together with the missing upper portions of the stakes described, formerly extended for some distance above the planks, and afforded a shelter from the sun or wind.

About opposite the middle of the shelter and in close contiguity to it, was found a heap of flints, some quartzite hammer-stones, a large roughly made side-scraper, a number of flint flakes and burnt flints, associated with blackened sand. Here, it seems, was some sort of habitation where the manufacture of flint implements was carried on.

It is possible that this structure is all that remains of the lower portion of a "wind screen"—such as was used by the primitive Australians and Tasma-

nians, and if so, the Ipswich discovery is unique in England. As the windward side of the shelter faced approximately northwest, this may be an indication of the direction of the prevailing winds of the days when it was in use.

The artifacts found in the shelter are in every way comparable with others discovered in the lower floor, where it has been exposed in other parts of the brick field, and there would seem little doubt that since this floor was occupied by man, the valley has been deepened by water action, and hill washes, derived from the ancient deposits on either plank, and of apparently different ages, have been laid down over the prehistoric land surface. (Figure 6.)

The wooden structure was found under deposits about five feet in depth and these strata appeared quite unbroken and without question, ran in under the adjacent terrace. (Figure 2.) Thus it does not seem possible to suppose that the wooden remains can be other than the same age as the lower floor. This would seem unquestionably to be of the period of the Stone Age, but the exact phase of the epoch that is represented is at present in dispute.

English archaeologists at the present time are much exercised as to whether the open air encampments of later Old Stone Age man, which were found in so many places in northern France by the late Professor Comment, occur in England. The former presence of hunters of these times in the caves of Derbyshire, South Wales, Cheddar, and Torquay is generally recognized, as is the fact that these people must have progressed across the breadth of England in reaching these places, and in all probability encamped in the open on their way.

How Ancient Is the Find?

But, although a number of ancient floors or occupation levels have been discovered in eastern England, buried under certain superficial deposits which, judging from the general geological evidence would appear to have been laid down in later Old Stone Age times, yet a great divergence of opinion has made itself manifest as to whether these floors are referable to the latter epoch or to some hitherto unrecognized and early phase of the culminating period of the Stone Age—the Neolithic, or New Stone Age.

The researches that have been carried out in Suffolk over a long stretch of years have established the fact that the latest glacial boulder clay (laid down by an ice sheet) of this area was deposited just after early Le Moustier—middle Old Stone Age—times, and it would be expected, therefore, that the remains of the succeeding races of people who

UNCOVERING THE LOWER FLOOR

FIGURE 4: *Looking north toward the escarpment. The lower floor is about 18 inches below the workman's feet*

inhabited England would be found in the beds laid down immediately subsequent to the retreat of the ice which was responsible for this boulder clay. It is necessary to remember, however, that after this retreat, no drastic geological changes have taken place in Suffolk, and that the post-boulder clay on the slopes of the now streamless valleys tributary to the main drainage system are, as would be expected, hill washes (the result of the slow wearing away of the slopes) of different kinds and ages. (Figure 6.)

The later Old Stone Age beds described by Comment are of the same nature, and, as England was joined to the Continent in those days, they were no doubt laid down under very similar conditions. But the geologist can at present give no opinion as to the exact date of these English accumulations, as being later in date than the latest boulder clay of East Anglia. He would class them simply as geologically "recent," or post-glacial, and there leave the matter.

The archaeologist, on the other hand, is somewhat perturbed by the appearance in the floors that have been found, of specimens of crude pottery such as have not yet been recorded from the later Old Stone Age deposits in the caves of France, although there is good reason to believe that similar examples of the potter's art were unearthed some years ago in certain upper Le Moustier horizons (those of Neanderthal man) in one or two Belgian caverns.

In view, therefore, of these geological and archaeological difficulties, which will no doubt disappear as more discoveries are made, it is not possible to say with absolute certainty whether the ancient occupation levels found in Suffolk are to be referred to later Old Stone Age or to Neolithic times.

When uncovered, the wood composing the remains of the ancient structure seemed to be in a very good state of preservation, but it was soon found that it would not stand exposure to the air and it has been found necessary to keep it immersed in a suitable liquid in order to preserve it.

About fifteen yards to the west of where the discovery was made, the remains of what appeared to be another shelter were found. But, in this case only a portion of one of the supporting stakes and some small branches were recovered.

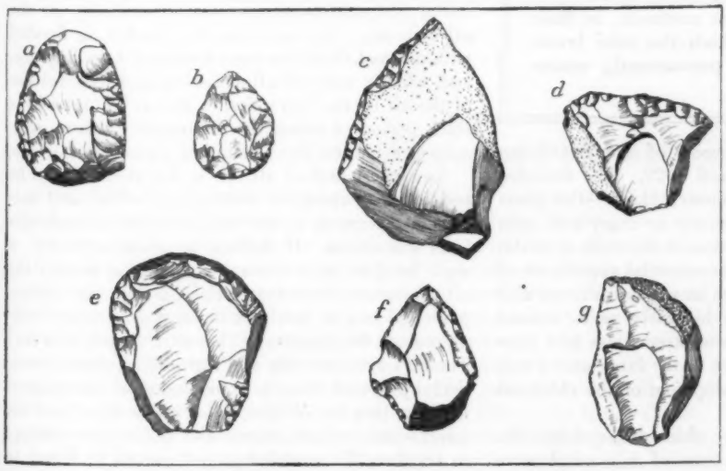
Judging by the large number of flints, broken by extreme heat or cold at the level of the lower floor, it seems that this period was marked by somewhat severe climatic conditions and these may have been the cause of the evacuation of the valley by the primitive inhabitants. When this happened their habitations would have gradually decayed and fallen down, to be covered up by the sand and other material then being deposited in the valley. (Figure 4.) This deposition would cover up the old surface springs, and cause much water-logging of areas of the lower floor, and there is no doubt that it was at such a place, where the conditions were exceptionally favorable for the preservation of wood, that the discovery of this remarkable structure has been made.

The valley in which the brickfield is situated is extraordinary rich in the remains of various races of prehistoric people, and in addition contains a late Roman cemetery and other relics of this period.

The Work of Neanderthal Man?

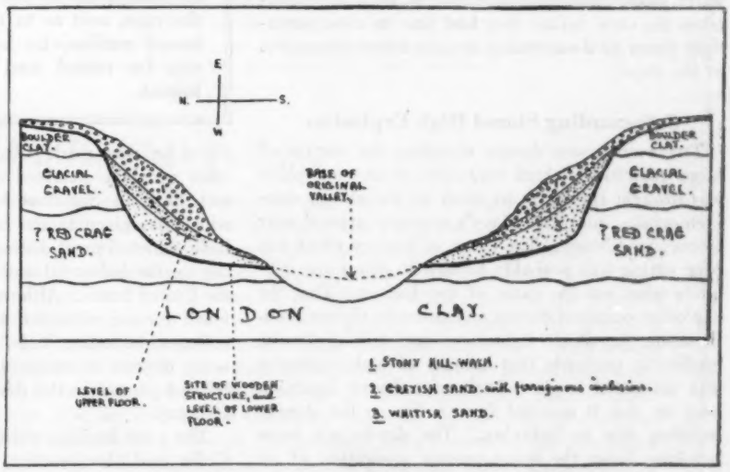
It is to be hoped that the further excavations now in progress will be successful in finding other examples of these ancient and important habitations of early man. By experiments which I have carried out, I believe it possible that the wood found could have been shaped by a sharp flint and split off a trunk by means of stone wedges.

The opinion of the late Professor Comment was that the flint implements found at the level of the lower floor are to be referred to a phase of the upper Le Moustier or Mousterian (time of Neanderthal man) part of the Old Stone Age. This view is shared by many English archaeologists, among whom I am to be numbered. It is possible, therefore, that in this new discovery we see for the first time the remains of one of the wooden dwellings of later Old Stone Age times.



FLINT IMPLEMENTS FOUND IN OCCUPATION FLOORS

FIGURE 5: a *and* b *are hand axes;* c *and* d *are side scrapers;* e *is a large scraper;* f *is a point for boring, and* g *is a knife having a more or less straight cutting edge*



THE VALLEY OF THE IMPORTANT DISCOVERY

FIGURE 6: *Diagrammatic cross-section of the valley (not drawn to scale), showing the position of the wooden habitation and the level of the upper and lower floors*

Our Point of View

The Salvage of the S-51

WHEN the submarine *S-51* was so brutally cut down and sunk in 130 feet of water, it is probable that few people believed she would ever be raised and brought to a naval drydock. The spot where she was put down is open to the scend of the Atlantic seas and the uncertain weather which prevails at Block Island, 10 miles from whose shores the vessel was sunk. Furthermore, even should the wreck be lifted, there would be a voyage of about 140 miles to be undertaken before she could reach a suitable drydock. Yet, this most difficult task has been accomplished, and at the present writing the *S-51* rests in one of the drydocks of our most important Navy Yard.

It is probable that the major objects of the Navy Department in undertaking to recover the vessel, were, first, to bring home and give decent burial to the officers and men who went down with the ship, and secondly, to make a minute examination of the hull, and particularly of the enormous gash on her port side, so as to uncover the last shred of evidence whereby to determine at whose door the responsibility for the tragic loss of the ship and her crew is to be laid.

The salvage of the *S-51* is the most brilliant feat of its kind recorded in all the long history of the United States Navy, particularly when we bear in mind the great weight of the vessel of 1,000 tons or more and the fact that the lifting of the vessel by means of pontoons—always a delicate operation—had to be undertaken in waters that were rarely quiet and often decidedly rough. Great credit is due to Lieut-Commander Ellsberg and the officers and men who collaborated in this work. It is also pathetically gratifying to learn that the preliminary examination of the interior of the boat proved that the personnel of the *S-51* stayed at their posts during the few minutes which elapsed between the cutting down of the submarine and her plunge to the bottom. As we stood on the edge of the drydock and watched the falling waters uncover the great gash on the port side of the ship, it was evident from the infolding of the plating that the submarine was overridden from behind by a vessel overtaking her on the port side. Moreover, it was easy to see from the size of the hole that the enormous inrush of water, sweeping everything before it, must have overtaken the crew before they had time to close watertight doors or do anything to save either themselves or the ship.

Safeguarding Stored High Explosives

THE ever-present danger attending the storage of large quantities of high explosives in any one place was brought tragically to mind by the almost complete wiping out of the Navy's extensive arsenal near Dover, New Jersey. The Court of Inquiry which has been sitting will probably be able to determine definitely what was the cause of the disaster. That the explosion occurred during an extremely violent thunderstorm in which lightning was striking freely, renders it probable that a mass of high explosive was detonated by the shock of a heavy lightning bolt, or that it resulted from a fire in the storage building due to lightning. The deadly air wave resulting from the instantaneous generation of an enormous volume of gas at high pressure, swept the neighborhood clear of all obstructions, demolishing factory buildings, storehouses and the homes of the officers and men, to say nothing of the homes of private civilians.

A most impressive lesson of the disaster is the folly of allowing villages and isolated residences to spring up in close proximity to such an arsenal as that which was wrecked by this explosion. Wherever there is a large storage of high explosives—nitro-glycerine, T. N. T. or what not—a belt of the surrounding country, sufficiently wide for its extremities to be beyond the severely destructive effects of an explosion, should invariably be provided.

Passing of a Great Captain of Industry

IN the death of Charles Albert Coffin, industrial America loses one of its outstanding figures, for Mr. Coffin was President of the General Electric Company from its organization until June, 1913, when he was made Chairman of the Board—an office which he retained until 1922. The deceased was born in Somerset County, Maine—that state which has given to the country so many men who have achieved great distinction in the work of building up the industrial and commercial supremacy of the United States. Although he was not favored with much formal education in his early years, several colleges, including Yale, conferred upon him honorary degrees in recognition of the large part which he had played in the development of the electrical industry.

The great business ability which distinguished Mr. Coffin and the practical turn of his mind were coupled with an idealism which made him keenly alive to what might be called the humanitarian side of the electrical industry, as manifested in the lightening of labor and the increase of comfort throughout the community, alike in the factory and the home, in the city and on the farm. He was "gifted with a breadth of vision that enabled him to visualize business as something more than an opportunity to pay fair wages to workers and to earn fair profits for stockholders." One of his achievements was the organization of the Research Laboratory at Schenectady, whose able staff, down through the years, have made such notable contributions to our store of scientific knowledge. Four years ago, the General Electric Company established a fund of $400,000 to be known as the Charles A. Coffin Fund—the income of which is being used to encourage the study and application of the science of electricity—a lasting and appropriate memorial.

Truth About Great Lake Levels

Doubtless, many of the facts which are brought out in our article on the burning question of the Great Lake levels, as published on another page, will prove to be unexpected and indeed startling to most of our readers. This was to be expected, for a vast amount of misinformation has been deliberately written and broadcast about this intricate and very serious problem.

In view of the difficult and highly technical nature of this controversy, we decided, in response to the request of a leading citizen of Detroit, to visit the lake district and make a personal inspection on the spot. Through the courtesy of Secretary Hoover, the Corps of Engineers of the Army, the engineers of the Sanitary District of Chicago, and the head of the Weather Bureau in Washington, we were able to go over the official records, reports, letters, et cetera and discuss the question with the leading officials of these various bodies. It was surprising and gratifying to find that there is practically a unanimous agreement among the engineers of the Army, of the Sanitary District of Chicago, and of the Canadian engineers, as to the underlying facts of the case, and as to the methods, in their broad outline, by which the lake levels can be raised and permanently maintained.

Avoid Government Regulation

IN the present issue we close our discussion of the petroleum industry as forming part of the series on conservation. We have dwelt upon the extravagance of the past, the economical methods of the present, and the promise of the future. We have seen that ten percent of the gasoline production now comes from the gas which formerly was wasted into the air as a nuisance. We have seen that where once the gushing well found the operating crew unprepared and poured out millions of barrels, to waste away in crudely constructed reservoirs, today, the head of the well is capped, and both gas and oil are conducted, without waste, to gastight reservoirs. We have seen that by the new and remarkable system of cracking, it has been possible greatly to increase the yield of the valuable gasoline from a given quantity of crude oil. Lastly, we have drawn attention to the fact that efforts are being made to produce more economical motors and supply them with grades of anti-knock fuel suitable to their effective operation—this last development alone promising a larger saving of gasoline than all the other efforts combined.

The above facts are all to the good. But we have seen, also, that the great blot upon the industry is the mad rush to drive innumerable wells around one well that has struck oil. We have seen that there is no general plan or well thought out procedure in recovering the crude oil. Furthermore, all this wild effort to get the oil to the surface and sell it as quickly as possible is not only wasteful but has produced and still produces great irregularity in the oil industry. At one time, the market is flooded with oil, and there is a corresponding drop in price, and, what is worst of all, a foolish and wasteful use of the oil by the "joy-rider." This is followed by a slack period in which the oil industry shivers with apprehension lest there should be a positive shortage.

Now, the moral of all this is that there should be restricted, cooperative drilling of wells, and this thought brings us to the sentiment which heads this brief discussion. If drilling is to be regulated, it must be done by voluntary cooperation among the oil operators themselves. Failing that, the nation, panic-stricken, is liable to demand government regulation of the industry. This would spell disaster! The oil operators—big and little—have done a wonderful job, even though, in the matter of unregulated drilling, they are at fault. But rather than have the government—which means the politician—attempt to regulate this vast industry, it would be better to let well enough alone, and allow the able and experienced men who have developed our marvelous oil industry to regulate themselves.

COMPLETE BED FIRE-ESCAPE

The device is built separate from the building. It will still stand, even if the entire building collapses

All photographs by Fotograms

AT THE TOP OF THE CONVEYOR

Here the patient's bed is placed on the endless chains, being held in position by extended handles that rest on rungs located at intervals on the chains. The descent of the bed to ground level is controlled by means of a single brake mechanism

READY TO BE CARRIED OFF

The bed has been lowered, by gravity, to ground level and is here shown resting on the landing frame in a convenient position for removal to a safer location

Fire-escape for Bed-ridden Hospital Patients

Fire, which always inspires fear and panic when it starts in a building, is at its worst when it menaces those that are helpless. In hospitals, the patients that are confined to bed are often at the entire mercy of the flames. Beds are awkward to carry down flights of stairs and there are many records of hospital conflagrations where it was found impossible to remove the patients on the upper floors due to the stairway construction. It was with these unfortunate victims in mind that the fire-escape system illustrated above was designed. In essence, this system consists of specially constructed beds and a series of endless chains that extend from the highest floor to the ground. The beds are equipped with telescoping handles. On the endless chains, there are horizontal rungs so arranged that the extended bed handles will rest upon them. When a fire occurs, the nurses or other attendants pull out the handles, roll or carry the bed and patient to the nearest fire-escape platform and place the bed in position on the bars. A manually operated brake is then released and the bed is slowly lowered to the ground, its progress and speed being regulated by the brake. When it reaches the bottom, the bed rests on a substantial framework from which it is easily and quickly removed by other attendants, leaving the platform and frame ready to receive the next patient. Throughout its operation, this system uses no motive power other than that of gravity. With several of these fire-escapes on a hospital building, it will be almost impossible for patients to be cut off from escape by the progress of a fire. Furthermore, after the beds are on the escape platform, the patients are comparatively safe, as even though the building should cave in, the fire-escape framework will remain standing as it is a separate unit. Thus, safety is offered to inmates of institutions where these fire-escapes are used.

A Twenty-five Foot "Eye"

Astronomers Have Planned a Monster Telescope, Many Times Greater Than the Largest Now in Existence. Its Actual Construction Awaits the Necessary Funds. A 1600-Ton Marvel of Mechanical Precision

By Henry Norris Russell, Ph.D.
Professor of Astronomy, Princeton University
Research Associate of the Mt. Wilson Observatory of the Carnegie Institution of Washington

WE considered last month some of the hopes and dreams of astronomers, but we left out one of the most important dreams of all—the dream of greater telescopes. We astronomers have great telescopes already—the greatest of all, the Hooker reflecting telescope of the Mt. Wilson Observatory, with its hundred inches of clear diameter, and its hundred tons of delicately balanced moving metal—is but a few minutes walk from the spot where these lines are written. Why do we dream of more?

In the first place, every gain in telescopic power has brought with it the solution of problems that could not previously be cleared up. To take but a single instance, the hundred-inch reflector shows—what smaller instruments just cannot do with certainty—that the outer portions of the great spiral nebulae are composed of clouds of incalculable numbers of stars. What a still greater instrument might reveal in other nebulae, or the planets, and perhaps even on the moon, is tempting to think of.

Secondly, the astronomer is always eager to extend his studies and to test his theories by observations of all kinds upon the fainter stars—and in this pursuit he becomes accustomed to expose plates for many hours and even on many successive nights. With a greater telescope, collecting more light, these exposures would be far shorter. And by making longer ones he could get at still fainter stars—which are at present beyond reach.

Nor would the study of the brighter stars be unaffected. With more light, more powerful spectroscopes could be used, and we might get detailed knowledge more nearly comparable to what we have now concerning the sun.

But could a huge telescope, far exceeding anything that now exists, be built at all? A very definite answer to this question has just been given by Mr. Pease whose extensive experience in connection with the design and construction of the hundred-inch telescope makes his judgment second to none. According to Mr. Pease, "anything up to a telescope a hundred feet in aperture can be built, provided one wants to pay for it." In putting his dreams on paper, however, he has been more moderate and has made a serious and detailed study of the problems presented by a reflecting telescope three hundred inches—twenty-five feet!—in aperture.

A Rare Combination

In 1672, Sir Isaac Newton presented to the Royal Society a little six-inch model of a new kind of telescope. Instead of being passed through a large lens, the light was to be reflected to a focus for a concave mirror. This was the first reflecting telescope ever made.

It is a long way from Newton's little telescope to the immense instrument shown on the opposite page.

Few realize adequately the nature of the problems involved in creating such a large piece of machinery—for a machine it is. Nor is the extremely minute criterion of accuracy demanded in the construction of the optical parts—nearly a millionth of an inch—fully sensed by all. A body weighing 1,600 tons must be mounted in such a manner that it can be moved with utmost ease, yet will maintain the most exacting geometrical relationship with its base. And the designer must not only understand mechanics but he must also know telescopes and astronomy. This is indeed a rare combination.

If the proposed instrument was as long in proportion to its breadth, as the present hundred-inch telescope, the tube would have to be 130 feet in length; but it would be practicable, and desirable, to give the mirror a deeper curvature, reducing the focal length to 1,000 inches, and making the skeleton tube of the instrument 86 feet long over all and 35 feet in outside diameter. Observations could be made, when desired, at the primary focus at the upper end of this long tube; but, in most instances, a secondary convex mirror, about 100 inches in diameter, would reflect the rays back to the lower end, giving an image on the scale which corresponds to an "equivalent focal length" of 200 feet.

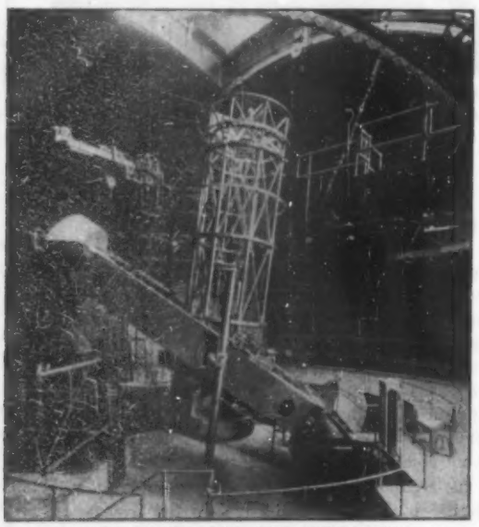
Photographs taken with this arrangement would show images of the moon nearly two feet in diameter and of Jupiter more than half an inch across. Enlargement of the image to twice or three times the size, on the plates on which it was photographed, could easily be made by lenses acting after the fashion of the familiar telephoto combinations (as is already done with smaller instruments). The exposure times would still be short, and, under good atmospheric conditions, a wealth of detail might be photographed.

As is done in some of the largest existing telescopes, the light when it was used in a reflecting telescope having this "Cassegrain form" would pass through a hole in the center of the great mirror, and the observer would be stationed at the lower end of the telescope, looking up toward the sky.

Most of the work with the great telescopes is done by feeding the light collected by the big mirror to some auxiliary instrument—spectroscope, photometer, thermocouple for measuring heat, and the like. At the present time, even with the largest instrument, these auxiliary pieces of apparatus, which often weigh many hundreds of pounds, have to be attached to the telescope and removed to make room for others—a task which requires skill, care, often considerable physical effort, and always a good deal of time. The last item is not serious when the changes are made in the daytime; but it practically precludes the making of more than one kind of observation on a single night.

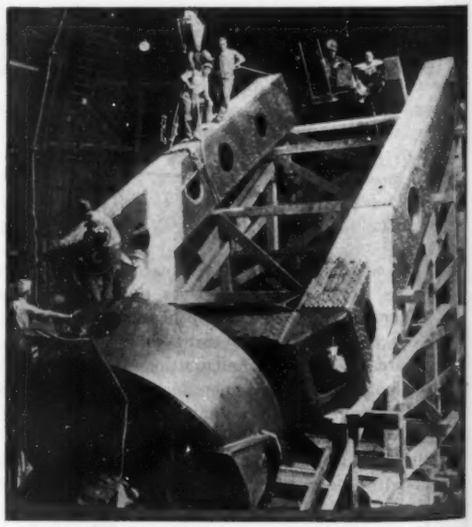
With the proposed telescope, these various instruments could all be permanently attached to the lower end—radiating outwards in various directions of the 35-foot circle, and a simple diagonal reflector would suffice to send the light out toward any one of them that might be chosen to work with. This would save a great deal of time and labor and an object of exceptional interest, such as a new star, could be observed in all sorts of ways on the same night.

With existing telescopes, too, the observer is carried on an "observing platform" of one sort or another, which can be shifted from place to place as the telescope turns to follow the stars—and even so, he is sometimes forced into decidedly inconvenient positions. The new telescope would be so huge that the weight of a man—or of two or three—at the lower end would not disturb its running at all. The observer would therefore be carried on the telescope itself—in some sort of seat at the middle of the lower end, requiring only relatively simple ad-



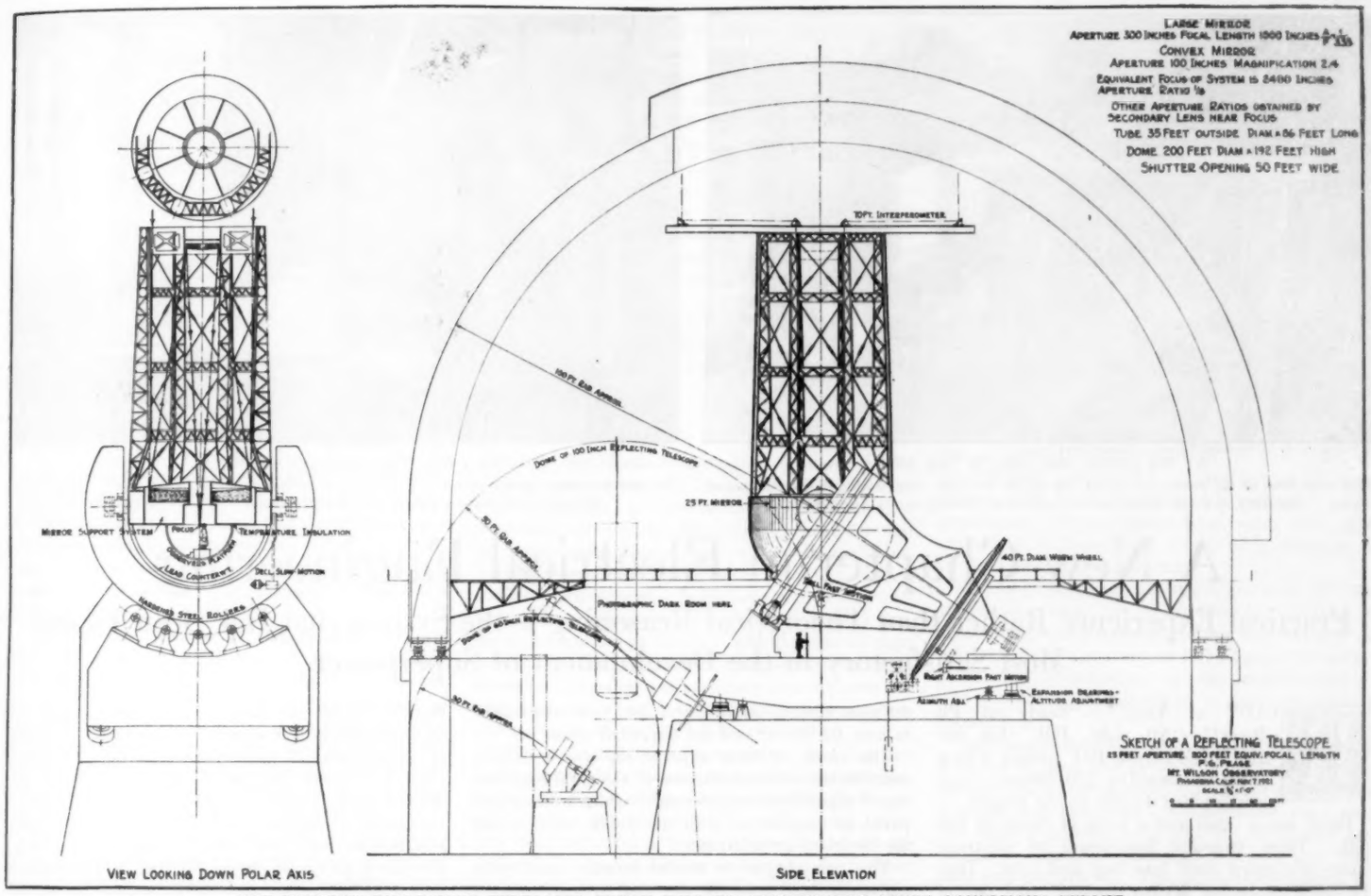
THE WORLD'S LARGEST TELESCOPE

The Hooker Telescope at Mt. Wilson Observatory, with 100-inch mirror. It is sketched in to scale on the drawing on the opposite page



BUILDING THE HOOKER TELESCOPE, 1916

Lowering a ten-ton side of the yoke into place. Even this giant telescope would be dwarfed by the one proposed in this article



THE IMMENSE REFLECTING TELESCOPE WHICH WILL BE CONSTRUCTED WHEN CONDITIONS PERMIT

The mounting is of the equatorial ring type which is known to be particularly stable. Two axes at right angles to one another permit the telescope to be directed at all visible parts of the heavens. The mounting is of the Cassegrainian type in which the 25-foot mirror reflects the rays upward to a hyperboloidal mirror, which in turn reflects them through a hole in the large mirror to a focus behind it

justments to meet the varying angles which the telescope axis made with the vertical. Even if he were working at the upper end, he could find a seat in some sort of "cage" fixed on the middle of the upper end of the tube, around the plate holder which, although giving him room to move about, would block off but a negligible portion of the light received by the huge mirror.

The systems of electrical control by which the existing great telescopes can be manipulated by the observer, merely by pressing buttons, would work equally well in the new case, so that the observer could remain in his station, actually "aboard" the telescope, for hours at a time, shifting the dome as occasion demanded, adjusting the focus, and carrying on all the delicate "guiding" which keeps the star-images exactly in the desired place. From this point of view, the proposed telescope, despite its vast dimensions, would be more convenient to run than a small one which is light enough to be moved by hand, and it would be a luxury for the astronomer to operate it.

The mechanical and optical design of a great telescope involves only the use of well-established and tested principles. As Mr. Pease's drawing shows, the main tube would be mounted in a great, forked, polar axis, in such a way that it could be pointed to any spot on the visible heavens. The whole weight of the moving parts would be 1,600 tons. Modern roller bearings are known to be capable of handling even such heavy loads; and the necessary precision of running could doubtless be attained by careful construction. The optical parts, too, involve no uncertain innovations.

For so large an aperture, only a mirror could be considered at all—the construction of a lens being utterly out of the question. Mr. Pease, in a paper recently presented before the Astronomical Society of the Pacific, upon which the present account is based—gives a very interesting survey of the different materials out of which a mirror might imaginably be made, and concludes that a disk of glass would be the best according to our present knowledge. Metallic alloys, although hopeful, do not appear to be as good. Fused quartz, if it could be made in so great a size, would be best of all, for it expands very much less for a given rise of temperature, and so would change its shape much less if the temperature in the dome rose. Next to this in desirability, and at present within the range of the practicable, come the glasses of high silica content, like the familiar Pyrex, which expands much less than ordinary glass.

Estimated Cost—Twelve Million Dollars

The dome enclosing the great telescope would have to be 200 feet in diameter and 200 feet high—twice the size of that of the hundred-inch Hooker telescope; but here again the engineering problems are not unreasonably troublesome.

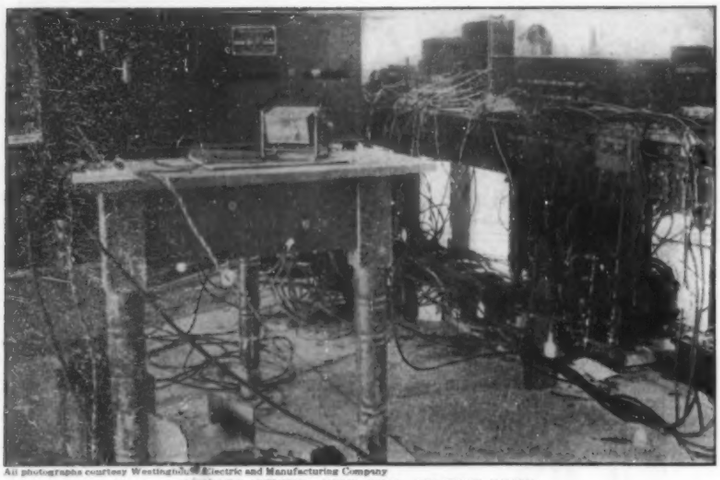
One of the most important of the scientific problems connected with such a telescope remains—its location. It would doubtless be used for a century at the very least, and many considerations have to be borne in mind—clear skies and steady air first of all—then healthy and tolerable living conditions for the observing staff, accessibility of engineering and machine shop aid, and, last but not least, stability, both of the material foundation against possible earthquakes, and of the governmental environment against possible wars or revolutions!

A good many sites, would however, meet the conditions named above fairly well, or better. From the purely astronomical standpoint, a location in the southern hemisphere would be decidedly preferable, as the most interesting region in the whole heavens—including the Magellanic Clouds, and the great star clouds of the Southern Milky Way—would then be accessible.

One more factor remains—counting the cost. Mr. Pease estimates, on the basis of present prices, that the great telescope, with dome and accessories, would cost some twelve millions of dollars. This is certainly a great sum; but the half million which has actually been spent on the hundred-inch telescope would have seemed equally impossible of attainment a generation or two ago. The investment, from the standpoint of science, would be a permanent one, and bring in large dividends of increased knowledge. The state of private benefactions has grown to such a degree that such a royal gift is not inconceivable.

One is tempted to reflect, too, that could some future conference of the powers see its way to some mutual international agreement involving the construction of one less battleship all around—and could this saving be devoted to science—we might see one such great telescope in the United States—in some good climate in the southwest—another on British soil, perhaps in South Africa, and a third, perchance in French Algeria.

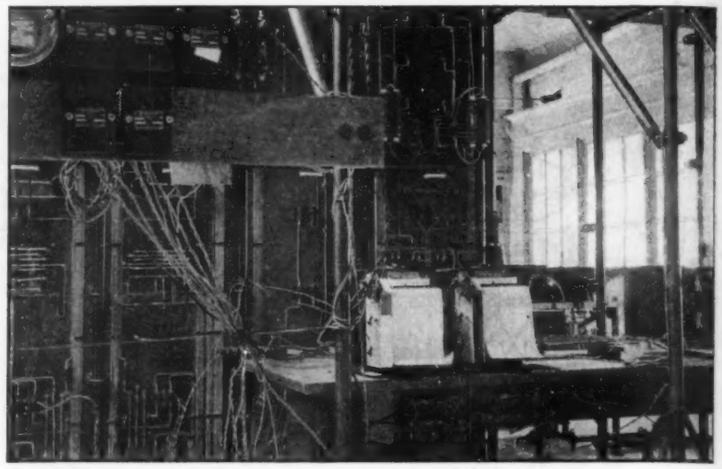
But this dream is taking on a political turn and it is time to awake.



All photographs courtesy Westinghouse Electric and Manufacturing Company

AT PIT RIVER, ONE END OF THE LINE

This apparatus, at the power generating end of the test line, suggests the thoroughness and intricacy of detail which entered into these short-circuiting experiments



AT VACA, THE OPPOSITE TERMINAL

To record certain phases of the tests, new and special instruments, in many cases, were designed and constructed for use in different parts of the test circuits

A New Chapter in Electrical Engineering

Practical Experience Rather than Theoretical Reasoning Is the System that Has Been Found Most Satisfactory in the Development of Superpower

READY at Vaca!"—"Ready at Pit River!"—"All right, Bill. Let her go!" Whereupon Bill, pulling a long rope, connected a 220,000-volt transmission line directly to the ground.

There was a crash and a burst of flame 25 feet high. Three thousand horsepower of electrical energy dissipated itself into heat and light. Then the line's protective devices operated, and one of the most spectacular of electrical tests ever performed was over.

The point at issue was this—What happens to a long, high-voltage transmission line when things go wrong?

Here was a question for which there was no satisfactory answer. Small-scale experiments, artificial lines, and other laboratory methods, although exceedingly useful in solving problems connected with transmission lines of ordinary length, had failed to provide data which checked with the results of actual experience in the case of very long lines.

Back to Nature for an Answer

The answer had to be obtained, however, and the only way to get it was to "go back to nature." So a group of engineers decided to take a few chances and try some life-sized tests.

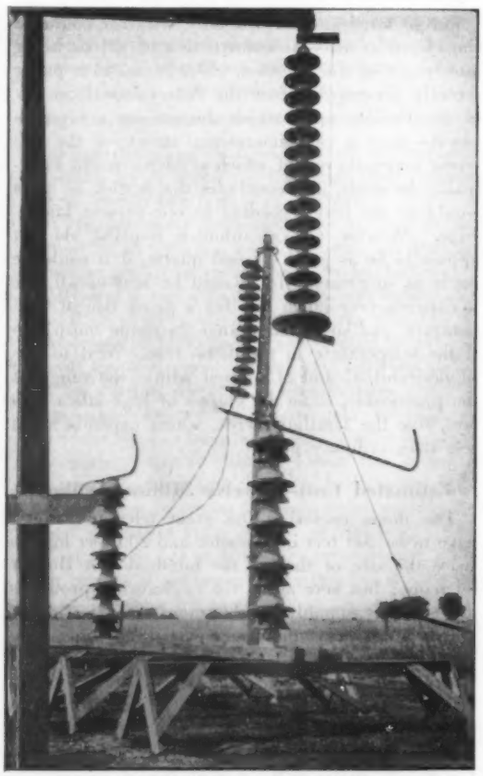
Dividing themselves into two groups, they installed themselves at either end of a 202-mile transmission line of the Pacific Gas and Electric Company in northern California. One group was in the Pit River hydro-electric power house, where two 35,000 kilovolt-ampere generators are in operation, and the other group was 202 miles away at Vaca-Dixon, the point where the energy from the Pit River is poured into the general network of the power system. The two groups worked together through the use of telephone communication carried by a high frequency carrier current over the transmission line itself.

In order to reproduce various trouble conditions as closely as possible, a series of experiments was carried out with the generators, converters, circuit-breakers, and other machinery at both ends of the line. Exact information as to what was going on in the system was secured by means of special instruments, many of which were designed for this particular occasion. The most drastic test of all, the grounding of the line, was the "fireworks finish" in both the literal and the theatrical sense.

The result of these experiments was a notable contribution to a new chapter of electrical engineering—"superpower engineering"—which is being prepared in cooperation with the public utilities and the electrical manufacturers.

This new chapter is needed because many principles that hold good for electrical systems confined to restricted areas do not hold good in the case of long lines.

Of these principles, perhaps the most familiar is that "the higher the voltage, the farther current can be economically transmitted." In ordinary practice, if 13,000 volts is not sufficient to carry a given amount of power economically a given distance, the desired results can be secured by raising the voltage to 22,000, 44,000 or some other value. But when transmission lines are several hundred miles long, the rule is no longer necessarily true, and conditions may arise where no appreciable amount of power can be transmitted at any voltage.



SHORT-CIRCUITING DEVICE

Note the lengths of fuse wire across the insulators

Stability of Prime Importance

Let us take a line consisting of two insulated wires forming a transmission line about 700 miles long and let us apply, at one end an alternating voltage between the two wires by means of a generator of negligible reactance. The applied voltage will not appear instantaneously at the other end, but will take an appreciable, though very short time (1/240th of a second) to arrive. When this wave reaches the open end, it is reflected, producing a wave of the same magnitude but moving in the opposite direction, so that the voltage at the end of the line is doubled. This action is repeated again and again, with the result that within the small fraction of a second required for the operation of protective devices, the voltage may rise to upwards of 25 times its normal value. Obviously, such a line (which is called "unstable") is useless for power transmission.

This fact has been known for a long time, but until recently, no one worried about it. As long as transmission lines did not exceed 100 miles in length, effects of this sort were considered negligible. But now that distant waterpowers are being developed and long superpower lines are being run between systems, the situation has changed. The stability of long transmission lines has become a matter of prime importance.

This is especially true because a line connected to transformers and other common electrical devices begins to exhibit symptoms of instability at much shorter lengths than the simple line mentioned above.

The following description of an ordinary electrical accident may make this situation clear. Let us suppose a tree has fallen across a transmission line. It will, of course, cause a ground which means that a sudden rush of current takes place. This

extra demand for power causes the machines on the power system to readjust themselves and in so doing, they set up power oscillations or "surges." In a line of ordinary length, protected by devices invented by many engineers, this surging is automatically suppressed, and after a few seconds of disturbance everything gets back to normal. But in long lines it may happen, due to certain instability effects, that the surges cannot be stopped in the ordinary manner, but grow rapidly worse and worse, until finally the whole system has to be shut down to prevent disaster. Then everything must be started up again, which takes time.

Similar surges can be started by lightning flashes, the sudden cutting off of a heavy load, and other more or less frequent occurrences, so that unless a line is thoroughly stable there will be frequent interruptions in the service. Hence, the necessity for the new science of superpower engineering.

Most people have a rather vague conception of the characteristics of a generator and their relation to the operation of the rest of an electrical system. It does not necessarily follow that the characteristics that give successful operation in a steam plant serving a congested area will be equally successful when used to serve the same area through a long transmission line.

The characteristics of the transmission line are determined when the distance of transmission, the spacing between the wires, the sizes of the conductors and the frequency are given. The amount of power that can be transmitted over a line of given length and characteristics, when the voltages at each end are absolutely fixed, is proportional to the product of these two voltages and this is the only way in which the voltages enter into the problem.

The idea that a transmission line of any length may be operated up to the power limit determined by the carrying capacity of the conductors is a delusion. In practically all transmission lines of any appreciable length, as built today, the operating limit of stability is reached long before the maximum carrying capacity of the conductors is approached.

On account of the large investment in a transmission line, it is imperative to find some way of increasing its operating limit and the work that has been done in the last few years has been carried on, first of all to determine the factors that enter into the problem and secondly, to determine what operating limit is possible, having due regard to the maintenance of a satisfactory standard of service.

"The fundamentals of superpower engineering have now been thoroughly explored," the writer was told by C. L. Fortescue, transmission engineer of the Westinghouse Company, who, with J. P. Jollyman and Roy Wilkins of the Pacific Gas and Electric Company, conducted the Vaca-Pit River tests. "There is now no theoretical limit to either the length or the capacity of a transmission line. Effective measures to insure stability have been worked out, and although numerous details still remain to be perfected, operative transmission lines of any length needed in the United States can be constructed without difficulty.

Conservation a Driving Force

"All of the elements of an electric power system —the generating end, the transmission lines, and the load—affect the stability of the system, and each must have the proper characteristics in order that the system may remain stable under all conditions. To determine these characteristics, a careful study is made of each element. In the case of new construction, such as a generating plant or transmission line, the apparatus can be designed with the desired characteristics. The load, however, cannot ordinarily be altered and in many cases existing power houses are interconnected. Under such circumstances compensating devices of various kinds are installed.

"The generators and transmission lines for the hydro-electric development now under way at Conowingo, Maryland, which will supply 550,000 horsepower to the Philadelphia Electric Company, have been designed after a thorough investigation of the Philadelphia load to insure stability, and all other power installations, such as that proposed on the St. Lawrence River, will also be analyzed and designed from this same standpoint.

"The question of stability is constantly growing in importance because we are evidently entering into an era of long transmission lines of heavy capacity.

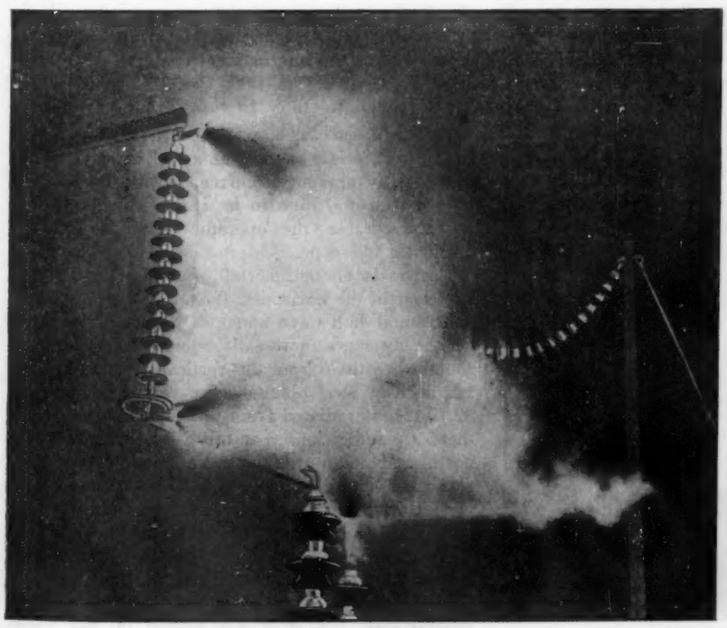
"There has been considerable misconception on this point, even among engineers. According to the prevalent idea, superpower means chiefly a balancing of systems, with the interconnecting lines carrying only the small volume of differential power. This is true enough under most conditions, but it must not be forgotten that one of the great advantages of superpower is the ability to secure power from a neighbor in case of an emergency. In other words, unless the lines interconnecting the different systems are able to carry sufficient power to compensate for the temporary shutting down of the largest station of interconnected companies, the full benefits of the arrangement may be lost when most needed. In general, therefore, interconnections between large utilities cannot be justified unless they can deliver a large quota of power.

"In addition, due to the increasing necessity of conserving fuel, we will develop more and more of our waterpowers, but unfortunately, nature works at cross purposes with the engineer in this connection. On one hand, she has made the sea coast, lakeside, and river bank the most attractive abiding place for the majority of people; and on the other she has located most waterpowers at considerable distances inland, and often in regions of naturally sparse population. Hence, power from water falls must ordinarily be transmitted considerable distances to be used to the best advantage.

"Stability is of dominating importance in long transmission lines, but certain troubles occurring in short lines, which have heretofore been referred to other causes, are now known to be due to instability, so that our investigations into the larger aspects of this question have enabled us to improve ordinary service."

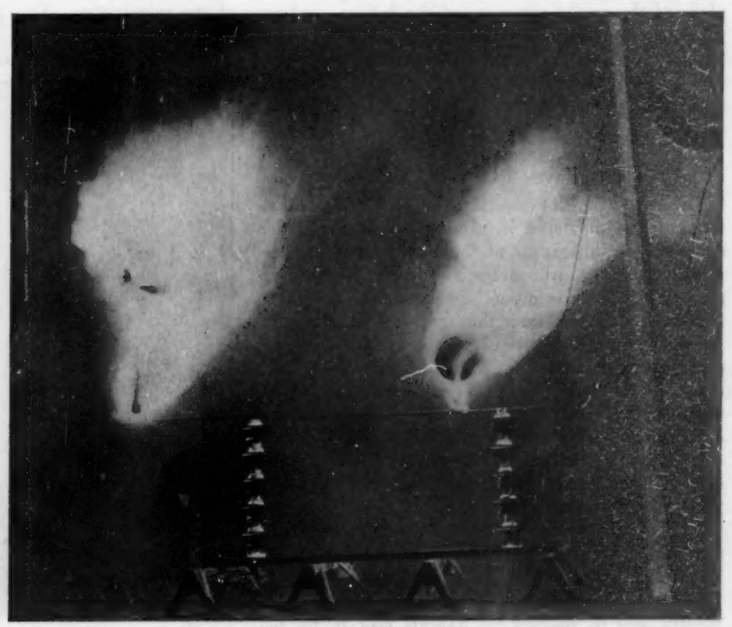
Superpower development is, therefore, not merely a matter of tying electric systems together by wires, but involves a new order of engineering and weighty financial considerations. Transmission lines over 100 miles long cost many millions of dollars and obviously cannot be constructed unless they earn their cost and upkeep. The superpower engineer is, however, working out all of these intricate problems and it is he who will in time make the superpower dream come true.

On the race tracks, new automobile refinements are tried out and if successful, they are used on pleasure cars. Be sure to read of this in the thrilling article on racing automobiles that will appear in our October issue.



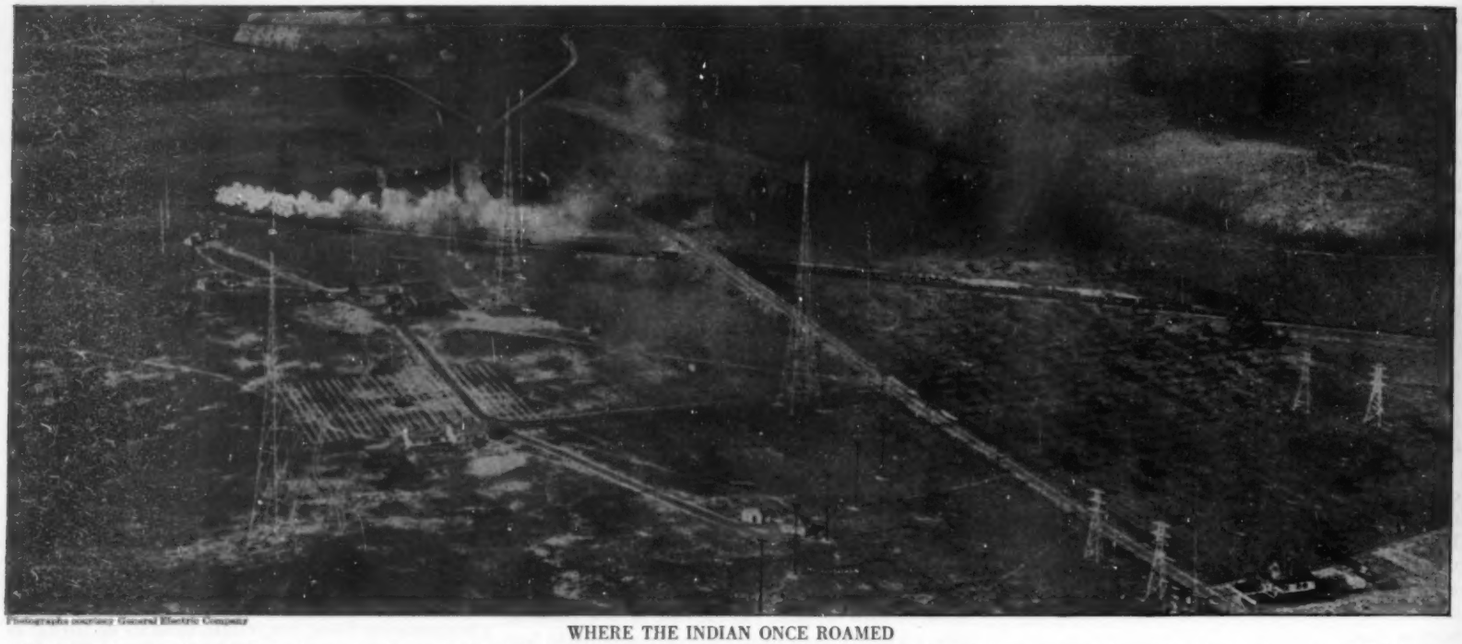
A VIEW OF THE FLASH

The short circuit is on. The fuse wires across the insulators are being consumed by the enormous current flowing through the circuit at the moment



FROM ANOTHER ANGLE

Each man at the tests was so busy with his own work that few saw the actual flash that was recorded by cameras. One of the resulting views is shown above



Photographs courtesy General Electric Company

WHERE THE INDIAN ONCE ROAMED

Weighty problems involving various phases of radio are thrashed out on this 54-acre radio reservation of the General Electric Company at Schenectady, New York. The parallel furrows show the ground system of the highpowered transmitter. The small buildings house the short-wave stations

Acres of Radio

Invisible Waves Shot Into the Sky from the Mohawk Valley Recall the Indian's Curling Columns of Smoke

By Orrin E. Dunlap, Jr.

IF the Red Men could wander down the long, long trail from the Happy Hunting Grounds to the Mohawk Valley they would see, instead of the wigwams of yore, an array of poles and masts holding aloft a network of copper wires. There in the foothills of the Adirondacks, on the level plains of South Schenectady, stand seven powerful broadcasting stations scattered over a 54-acre plot. In place of the smoke messages of the Indian, curling slowly into space, are invisible but powerful electric waves which carry dispatches, music and voice across world-wide distances to Australia, South Africa and distant lands in Europe at the speed of sunlight.

Short Waves Play Odd Pranks

This acreage, dotted with tiny wooden shacks, which house the latest in radio transmitters, is the development laboratory of the General Electric research engineers, who are studying the vagaries of the ether and transmission phenomenon on wavelengths from five to three thousand meters in length.

The seven transmitters can be operated simultaneously without the slightest interference with each other. A United States Navy band in Washington may be playing from one aerial; a dance orchestra on Broadway from another, while a variety of songs or talks are radiated from the other wires, some to come back as letters seeking verification of reception in different quarters of the globe. Such is the transformation that has taken place in communication since the Indians vanished from the Mohawk Valley.

The engineers, by observing the various wavelengths and in reading the reports sent in by listeners, are rapidly learning the tricks that radio plays upon the white man. The short waves, under 100 meters in length, seem to play a game of hop, skip and jump around the globe. It has been found that messages carried by the lower wave bands shoot high into the sky and are not reflected back to the surface of the earth until they cover hundreds of miles. In some cases they are not heard until they get more than 1,000 miles from their source. It has been noticed that the 20-meter signals do not come back to the earth within a radius of 400 miles of the transmitter. This is called the "jump-over" or "skip" effect. Dr. E. F. W. Alexanderson estimates that the 32.79-meter wave in its flight from Schenectady to Australia makes approximately three skips.

2XAF's AERIAL CONTACT WITH AUSTRALIA

This is the so-called half-wave type of antenna that has been found efficient for short-wave transmission

The layman in observing the wire network over this research field might select the 300-foot steel towers as the aerial supports responsible for girdling Mother Earth with radio music, but such an assumption would be wrong. Off in one corner of the radio reservation is an insignificant looking single length of wire 50 feet long and about the diameter of a lead pencil, suspended from an insulator hung by a rope from the yardarm atop a 70-foot telephone pole. This is the international contact!

Schenectady to South Africa

This wire is called a vertical half-wave aerial. In the exact center is hung an aerial ammeter which measures the amount of current flowing in the wire. It is a trifle too high to be read directly with the unaided eye, so the operator takes the reading through a telescope.

Nearby is another aerial of similar design but stretched in the horizontal direction. It is called a "horizontal half-wave antenna." Certain localities get the messages more satisfactorily from the horizontal wire than from the vertical aerial. For example, Key West obtains more reliable signals on 32.79 meters radiated from the horizontal wire and there are indications that this wire is superior for north and south communication. However, California observers notice no difference between the vertical and horizontal wire. England gets best results when the vertical wire is used.

Another peculiarity is that the short-wave transmitters require no ground connection. Installations tuned to radiate above 65 meters usually employ a counterpoise, but it is not needed on the lower channels. The big 50-kilowatt transmitter has a grid of wires buried in furrows beneath the aerial.

TUNING CAGES OF A SHORT-WAVE AERIAL

The small inductances are for the purpose of regulating the transmitter's wavelength. The meter denotes the amount of current in the antenna circuit

The high-power, water-cooled, vacuum-tube transmitters which feed the aerial of the 32.79-meter system are rated at 20 kilowatts. These tubes operate in a push-pull circuit. They are controlled by a quartz-crystal oscillator through an intermediate, harmonic amplifier which holds the station on its exact wavelength. The transmitter feeds approximately 13 kilowatts into the aerial.

So far do the signals from the short-wave transmitters travel, that it is difficult to determine which direction, or route, the waves take in their trip to foreign countries. One day at 5:30 PM, eastern standard time, a greeting from Secretary of Agriculture W. M. Jardine to the annual agricultural show in South Africa was radiated by station 2XAF from the 32.79-meter transmitter. The waves were detected by an amateur in Johannesburg, 8,500 miles from Schenectady, and he forwarded the electrical impulses from his receiver over land wires to station JB, Johannesburg, whence the American message was rebroadcast successfully to thousands of listeners.

Several weeks later, mail was received from Victoria, Australia, from an eavesdropper on the message destined for the farmers in South Africa. The letter said, "Very loud three hours after sunrise. If signal went east it covered 14,000 miles and if west about 11,000 miles."

Harry Sadenwater, who was operator on the United States Navy seaplane *NC-1* during the transatlantic flight in 1919, and who is now engineer in charge of technical operations of WGY, KOA and KGO said, "There is no way of estimating which way the messages travel to reach Australia. They may go via the north or south poles as far as we know."

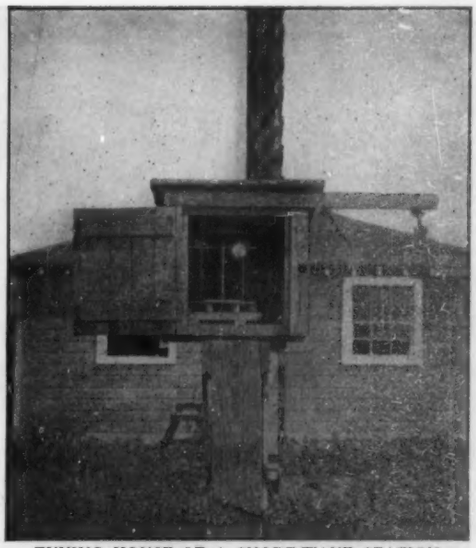
Mr. Sadenwater called attention to the fact that wireless code signals are about four times as reliable as voice or music when sent over long distances, because the dots and dashes are of comparatively uniform strength, while the different sounds in speech and music vary in intensity, some loud and others soft.

Dotted across the 54-acre field are the following broadcasting plants: WGY on 380 meters rated at 50 kilowatts. (This is the station broadcast listeners hear); station 2XAH, 10 kilowatts on 1,500 meters used for relaying programs to WCAD, Canton, New York, for rebroadcasting; station 2XK, 10 kilowatts on 109 or 65.1 meters; 2XAF, 10 kilowatts on 32.79 meters; 2XAW, 600 watts on 15 meters; 2XAC, 10 kilowatts on 50.2 meters for horizontal loop experiments, and 2XAD, 1 kilowatt on 26.4 meters.

Wood Used for Insulation

One brick building 60 by 100 feet serves as the power house and home of the 50-kilowatt installation. The other transmitters are housed in wooden buildings about 25 feet square. There are three steel masts arranged in the form of a triangle, so that various types of aerials can be tested. Three 80-foot wooden poles support the aerial of the 109-meter equipment. Other wooden masts hold aloft the aerials of the other short-wave radio transmitting stations.

The power building houses the high-voltage rectifiers, amplifying and modulating equipment. There are three rectifiers having a capacity of 150 kilowatts at 15,000 volts. These rectifiers convert the alternating current supplied to the station into direct current, which is used for the plate supply on the various transmitters. The modulating equipment is arranged so that it can be connected with any of the smaller buildings by means of overhead transmission wires. When the experimental stations radiate programs from the WGY studio in the city, they are sent over two miles of aerial cable which connects the microphone with the transmitters and allows perfect retransmission.

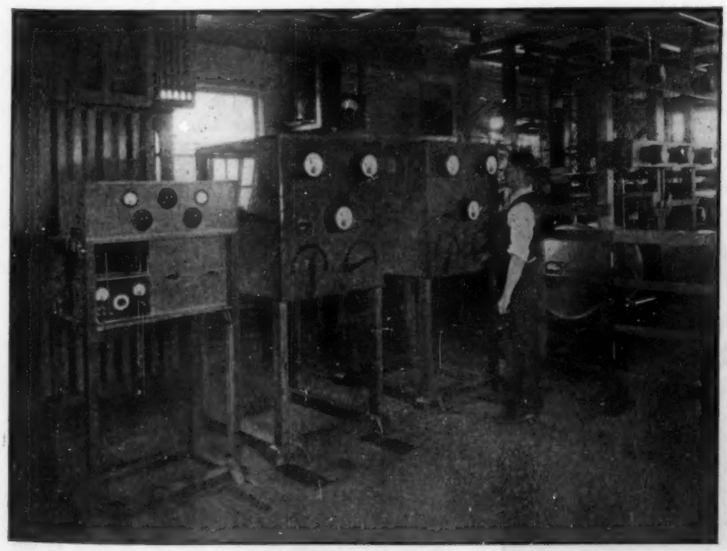


TUNING HOUSE OF A SHORT-WAVE STATION

At this point the radio-frequency feed lines from the transmitter are coupled through a tuned circuit to the short-wave transmitting antenna system

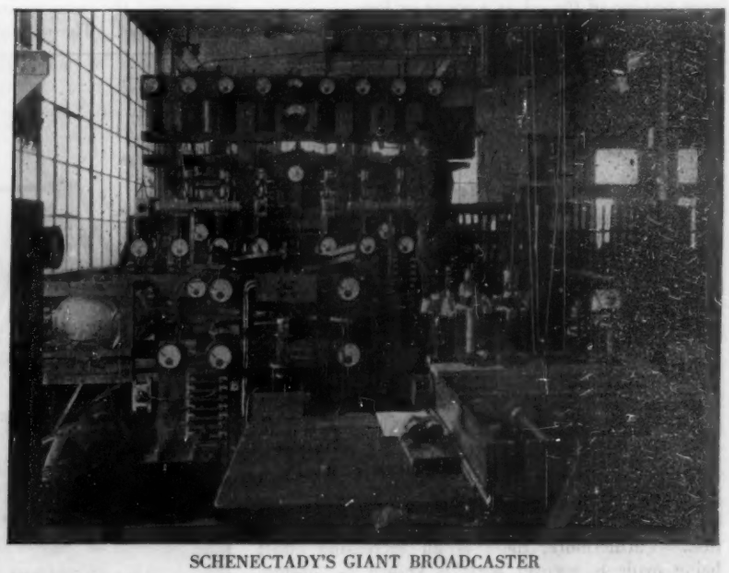
A dark room is provided in the main building for developing oscillograph films which record modulation. A circulating pump having a capacity of 150 gallons per minute supplies cooling water for the high-power tubes. The water is piped underground to all the radio shacks. In the main building the water is forced by a blower at a pressure of 55 pounds per square inch through a large radiator similar to the radiator of an automobile, thus keeping the temperature of the water at approximately 35 degrees, Fahrenheit.

The rubber hose carrying the water to the tubes and all of the electrical instruments which comprise the transmitters, are mounted on maple. The wooden frames have been given a special impregnating treatment to improve the insulating qualities, so that as much of the electrical energy as possible will get into space, just as the Indian smoldered his fire to create more smoke for his signal system.



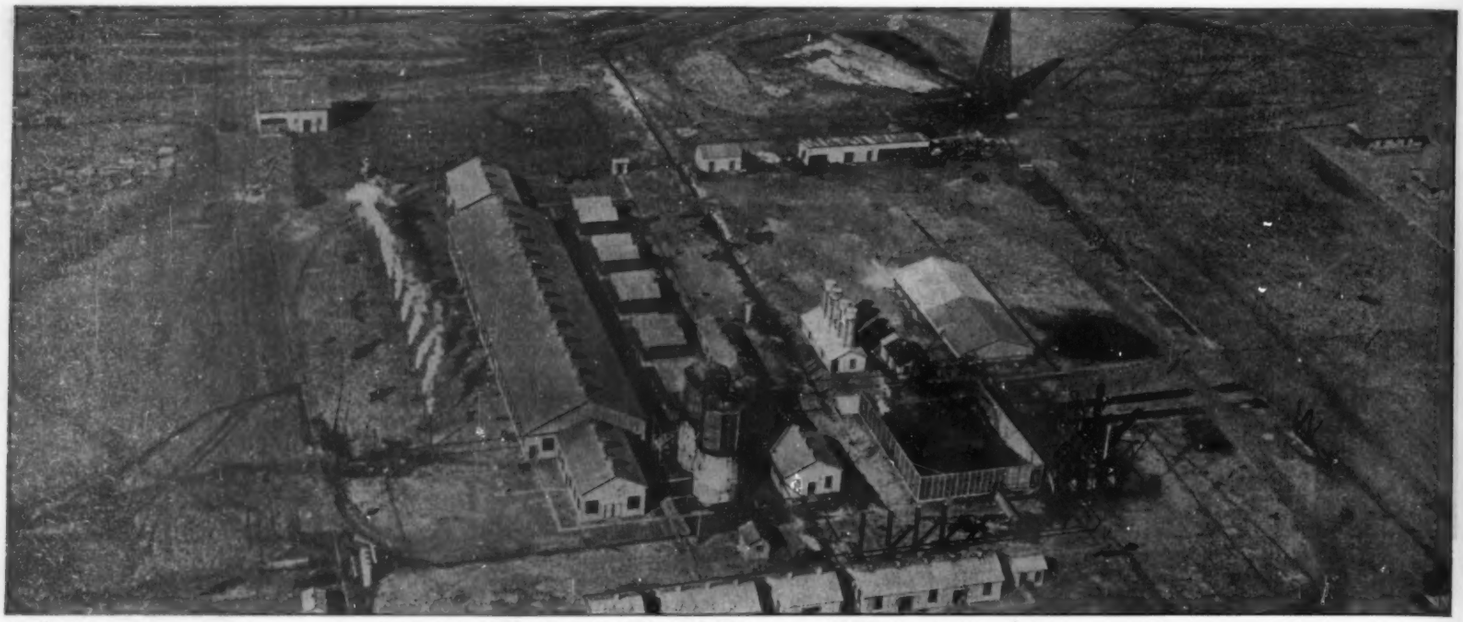
A 65-METER RADIO VOICE

This unit of the gigantic radio system at Schenectady, New York, operates on a wavelength of 65 meters. The crystal control oscillator at the left serves to hold the station on its exact wave and so prevent swinging as well as interference



SCHENECTADY'S GIANT BROADCASTER

This complete layout is rated at 50 kilowatts and has a large operating radius. When the transmitter is functioning, the operator cannot approach the instruments to read the meters and so he must employ a telescope for this purpose



CASING-HEAD GAS COMPRESSION PLANT WHERE GASOLINE IS OBTAINED FROM OIL WELL GAS

Uncle Sam, Spendthrift—IV

Conservation of Gasoline by Its Recovery from Gas; by Improved Refining Methods; and by Using Special Anti-Knock Gasoline in High-Speed Motors

By J. Bernard Walker

IN our preceding article on the conservation of petroleum (August issue) we dealt with the losses of petroleum due to the lack of organized scientific methods in drilling wells to get at the petroleum. It was shown that there is a general consensus among the oil men that for every barrel of oil brought to the surface, four are left in the ground. Inasmuch as the various proposed methods for bringing to the surface this 80 percent of the oil are at present largely experimental, and that such methods are being given only a very limited trial, it is not stretching a point too far to look upon this large residue of the oil as a waste or loss.

Furthermore, considering that we are merely skimming the cream of our oil reserves, and that we are using up this oil as fast as we get hold of it—living from hand to mouth—it cannot be denied that these discussions of the oil problem have a legitimate place under our title of "Uncle Sam, Spendthrift."

1,100,000,000 Gallons from Former Waste

In the present chapter, we deal with the wastes of oil above ground. At the outset it is only fair to state that, although in the earlier days of the industry the above-ground wastes were enormous, today, thanks to a better understanding of the problem and the adoption of highly developed methods of refining, there is comparatively little waste here.

The most valuable constituent of the crude oil is gasoline. At the present time, the greater part of the gasoline is recovered by distillation; but of late years there has been an increasing development of a method of recovery known as "cracking," in which a larger percentage of the valuable contents of the oil is recovered than is possible by simple distillation. Furthermore, there is an increasing effort being made to recover what is known as "casing-head" gasoline, that is to say, the gasoline which is to be found in the gas which flows from an oil well.

Casing-head gas is the natural gas, which, as we showed in the previous chapter, in the early days of the industry was very largely allowed to go to waste. The head of an up-to-date well is now covered with a tight casing, from which both the oil and the gas are carried to suitable storage. In recovering the gasoline, two methods are used. In the first, the gas is compressed and led through water-cooled coils, in which the gasoline is condensed and so recovered. In the other method, the gasoline is recovered by absorption—the gas being carried through various petroleum "fractions," ranging from heavy kerosene to light lubricating oils. In some cases, the compression and absorption methods are combined. The resulting gasoline is too volatile for use in motors and it must be blended with other gasoline before it can be placed upon the market.

A RIVER OIL WELL
This one is located on a sand bar in the Arkansas River

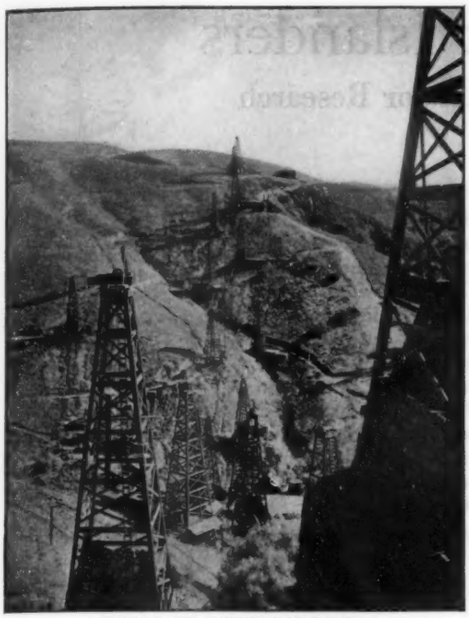
The recovery of casing-head gasoline from oil-well gas must be put down as one of the most meritorious developments of modern-day refining. The production from what was formerly considered as a waste has grown from practically nothing in 1911 to over 1,100,000,000 gallons in 1925. According to the report of the American Petroleum Institute to which reference was made in a previous chapter, there has been a gradual increase in the amount of gasoline obtained from casing-head gas, ranging from 0.2 of a gallon from gas to each barrel of oil produced in 1915 to approximately 1.4 gallons from gas to each barrel of oil produced in 1924.

Let us now consider the methods of recovery of gasoline from the oil itself, which is done in what are known as refineries. The simplest of these are those plants which practice what is known as "topping" or "skimming."

"Cracking" Increases Gasoline Production

In topping, merely the gasoline is extracted—this being done by a process of distillation. A skimming plant extracts the gasoline and the kerosene. There are other refineries which carry the distillation further and remove such fractions as lubricating oils and other less-known products. A "complete" refinery is equipped to obtain any desired fraction from the crude oil handled and can, within certain limits, increase or decrease, at will, the ratios of the several products obtained, thereby adapting its operations to market conditions. The desire to increase the ratio of gasoline recovery led to the development of so-called "cracking" processes, which have added enormously to the total gasoline production.

In the distillation process, the oil is kept in circulation through a series of stills and during its progress is subjected to various and increasing degrees of heat—the different fractions being thrown



WELLS ON BOUNDARY LINE

These oil wells are located on the line between two adjacent oil properties in Los Angeles County, California

off, successively, as the oil is raised to their temperature of volatilization. It will be understood that no chemical change takes place during this distillation.

In the cracking process, the molecules of the oil are broken up by quick changes of temperature under pressure, and, by chemical action a larger percentage of gasoline is recovered than is possible by simple distillation. The work is done in large stills, towers, et cetera. As in the case of the treatment of casing-head gas, there has been a steady growth in the use of the cracking process. The installation of a cracking plant calls for a large expenditure of capital, and consequently, the most extensive plants for the use of this process have been built by the large oil companies. Today, the amount of gasoline recovered by the cracking process represents 26.5 percent of the total output of gasoline.

The president of the Standard Oil Company, during his testimony before the Federal Oil Conservation Board, stated, that, in his opinion, "cracking has doubled our potential gasoline resources," and no one can dispute his statement that the new method of treatment "has effected a conservation measure of incalculable value."

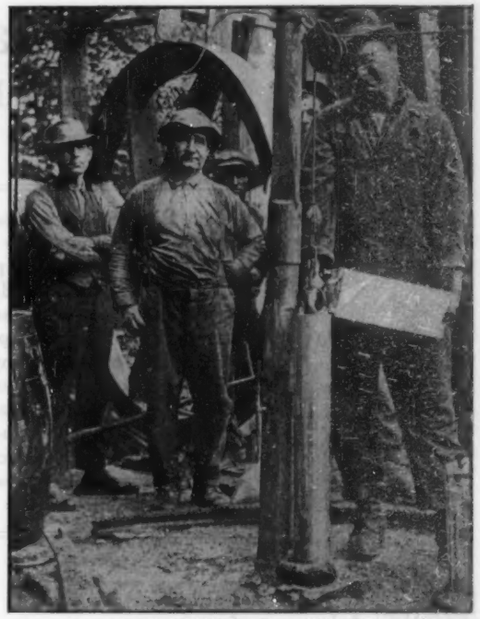
Before leaving this phase of the oil question, reference should be made to the rather frequent suggestion that, since fuel oil contains gasoline and other valuable oils, a restriction should be put upon its use for purposes which might just as well be served by coal. To this, the oil men answer that the question as to whether fuel oil should be used in furnaces or further reduced by cracking will be determined by the question of supply and demand and price. As the price of the gasoline rises, proportionately large amounts of crude oil will be treated by the cracking process, and the users of fuel oil will return to coal when the higher price of gasoline justifies the change.

In addition to the conservation of oil through the development of casing-head gas and cracking processes, there remains one other most promising field of conservation, which may well prove to be the most important of all. We refer to the development of special motor fuels and their use in a new type of high-compression, high-speed motor. Of the many men who have directed their attention to this most important subject, none stand out so pre-eminently as C. F. Kettering, who now for many years past, as president of the General Motors Research Corporation, has been untiring in his search for what has come to be known as "anti-knock" fuel. During this investigation, he has made some 10,000 experiments in an endeavor to find out just what was the cause of "knock," and what are the desirable conditions, both in the fuel and in the motor, to get rid of this trouble.

Motor and Oil Industries Must Cooperate

By the use of a gas-engine indicator, it was determined that knock is nothing more or less than detonation; that is to say, instead of the fuel burning gradually throughout the stroke of the piston, at some point during the stroke, detonation occurs, so that instead of a distributed pressure throughout this stroke, there is an increase of pressure, so rapid as to be somewhat similar to a blow of a sledge hammer upon the piston. Mr. Kettering has this to say:

"After a long series of tests, a certain type of straight-run gasoline, plus 40 percent of benzol, represents a base line for this new type of anti-knock motor fuel." The same authority stated before the Federal Oil Conservation Board that "the motor industry has felt that it was not feasible for them to make any radical changes in motor design, unless they were assured of universal distribution of fuel of the type mentioned above, from which the gain to the public would far outweigh the cost to them." Later he says, "before the American public can have more efficient cars, it is necessary for the oil industry to standardize and to get a national distribution of fuels which are of high anti-knock rating. It is safe to say that when this is done, the American public can expect a 20 to 40-percent increase in efficiency in their vehicles."



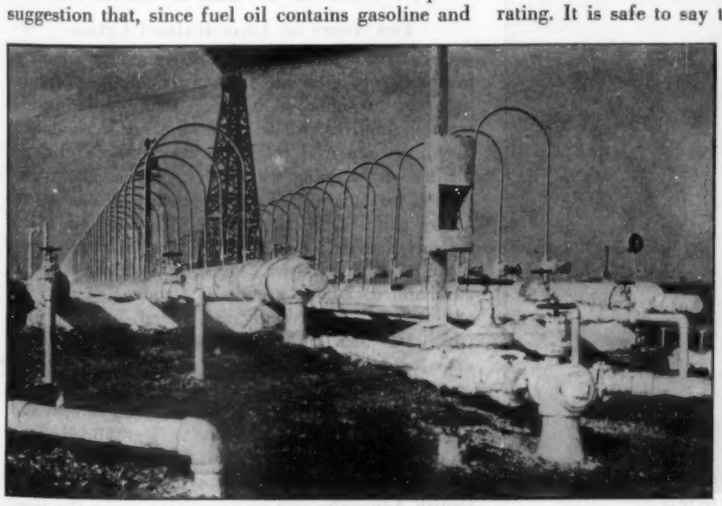
PREPARING FOR A "SHOT"

Pouring nitroglycerine into a shell that will be detonated at the bottom of the well to increase the oil flow

In all fairness to the oil industry, it should be stated that, when confronted with the above statement, they assert that, today, several of the larger oil companies are producing and marketing high-compression gasoline with the desired anti-knock properties; and that the record of the past renders it certain that such gasoline will be available in sufficient quantities.

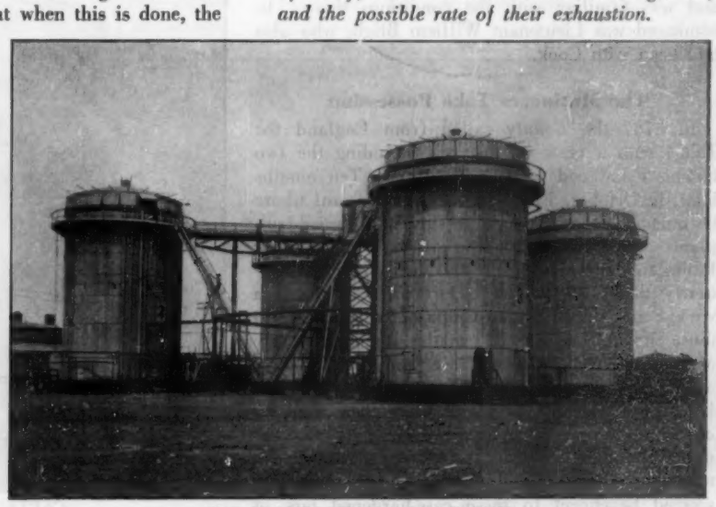
It is evident that the conservation of oil, when this shall have been accomplished, will be enormous. During the year 1925, over 9,000,000,000 gallons of gasoline were consumed in American cars. A 20 to 40-percent increase of mileage per gallon would mean a saving per year of from two to four billion gallons of gasoline. But since there are about 400,000,000 engine horsepower in the 20 million American cars of today, it is evident that the task of replacing the present motors with the new type can be accomplished only gradually.

¶ *The October chapter on conservation will deal with the mining of coal, pointing out the extravagant methods of the past, the improved practice of today, the coal reserves still in the ground, and the possible rate of their exhaustion.*



OIL GAS REMOVAL PLANT

These are gas traps where gas and oil are separated; gasoline is reclaimed from the gas



THE PURIFICATION OF GASOLINE

The four huge tanks are a battery of agitators used for purification at a Chicago plant

The Romance of the Norfolk Islanders

Modern Descendants of Mutineers Furnish Material for Research

By Dr. H. L. Shapiro

Pitcairn, once famous as the isolated Pacific island home of the mutineers of the *Bounty*, has become the center of scientific interest. The famous, or rather infamous, mutiny of the *Bounty* in 1789 took place in the Pacific and was followed by the settlement, on deserted and isolated Pitcairn Island, of some of the mutineers accompanied by their Tahitian wives. Forgotten by the world, the colony grew rapidly, after an initial series of murders. Rediscovered in 1808 by a Boston captain, the Pitcairn Islanders so impressed the whalers by the Arcadian simplicity and harmony of their peaceful lives that they became, in Victorian America and England, a source of text from which many sermons were preached. The increase of population forced the Pitcairn Islanders to migrate, in 1856, to Norfolk Island, 3,000 miles away. Their scientific interest is due to the fact that they are the offspring of a cross between representatives of two distinct racial groups. Practically everyone is related to everyone else on the island. It is fortunate that these descendants of the mutineers of the *Bounty* have been studied at the present time, since the proximity of Australia is rapidly changing these interesting people.

SCIENCE is not always as dry as dust. It has, very often, its compensations in romance as thrilling as any tale of the high seas. Even that famous crime of the Eighteenth Century, the mutiny of the *Bounty*, has, in this, the Twentieth Century, offered material for scientific investigation. The knowledge of this once famous mutiny and its sequel in the settlements on Pitcairn and Norfolk Islands is not widespread. But in the middle of the last century it was the subject of many pamphlets and lectures in England and in this country and was frequently cited as an example of Arcadian simplicity following crime and bloodshed, and of the ameliorating effect of Christianity.

When the earliest voyagers to the South Seas returned to Europe, they had many things to tell, one of which was of the exotic bread-fruit tree which served as the main source of food for many of the South Sea Islanders. The fruit of this tree, when roasted, was said to taste very much like newly baked bread. This easy source of food appealed to the imagination of the planters of the West Indies who petitioned His Majesty, King George III, to have these valuable plants carried to the West Indies to furnish sustenance for the plantation slaves. This request was granted, and the *Bounty*, a ship of about 200 tons burden, was outfitted at Deptford, under the direction of Sir Joseph Banks of the Royal Academy, who had made a trip with Captain Cook to Tahiti and was familiar with the conditions there. In command was Lieutenant William Bligh, who also had been with Cook.

The Mutineers Take Possession

In 1787 the *Bounty* sailed from England for Tahiti with a crew of forty-six including the two botanists assigned to the expedition. Ten months later, in October, 1788, Bligh reached Tahiti where he intended to secure a large supply of bread-fruit plants. He then planned to proceed to the West Indies to deliver his cargo. Tahiti proved particularly delightful to the sailors after a long sea voyage and the many hardships of nautical life in those times. They reveled in the abundant supply of unaccustomed tropical fruits and the pleasures of social intercourse which they immediately established with the natives. The white men were received with open arms; each having a "tyo" or native friend to look after his welfare. The women, too, were hospitable and attractive. Life must have seemed beneficent to these case-hardened tars of the *Bounty*. They were among the earliest of that long line of wanderers who have found the South Seas kind.

After a stay of almost six months Bligh sailed from Tahiti, April 14, 1788, and made for the Tonga or Friendly Islands. About two weeks later he was off Tofoa, one of the islands of that group, and with every assurance of a successful voyage. On the night of April 27, Bligh retired, his "mind being entirely free from any suspicion." The watch had been divided into three parts, Fletcher Christian, the master's mate, having the morning watch from four to eight.

Just before sunrise, Christian, who had been smarting under the insults of Bligh, was taken with the idea of seizing the ship. He found several of the sailors who fell in with the plan. It is said that, as a matter of fact, it was a sailor who originally suggested a mutiny to Christian. At any rate, Christian and his confederates secured possession of the arms on board ship and entered the captain's cabin where they made Bligh a prisoner. All the other officers were quelled before any attempt at resistance could be made. Bligh tried to remonstrate against the mutiny, but he was ordered, "Hold your tongue, Sir, or you are dead this instant."

Bligh again pleaded with Christian, saying, "I'll pawn my honor, I'll give my bond, Mr. Christian, never to think of this again, if you'll desist," and urged on behalf of his wife and family; to which Christian replied, "No, Captain Bligh, if you had any honor, things would not have come to this and if you had any regard for your wife and family, you should have thought of them before, and not behaved so much like a villian."

CAPTAIN BLIGH
The ill-fated commander of the Bounty

In response to another entreaty by the captain, he answered, "It is too late, I have been in hell this fortnight past, and now I am determined to bear it no longer," and, turning to the boatswain, "and you know, Mr. Cole, that I have been treated like a dog all the voyage."

Deaf to all appeals, Christian ordered the ship's boat lowered. He put the captain and eighteen of the crew into her and set her adrift in an uncharted sea. Bligh, with scanty provisions, in a boat dangerously low in the water, now made a voyage unparalleled in nautical history. Among the Fiji Islands, then unknown, to North Queensland, through Torres Straits and finally to Timor, an island near Java, a total distance of 3,618 miles, Bligh for some forty days directed the course of his frail boat through storms and burning heat, in hunger and thirst, to reach his goal and set up a reputation for seamanship which has lasted to this day. In spite of his personal character, which was, in certain respects harsh, he was an admirable and courageous navigator.

Ten Years of Unrestrained Crime

Christian, with the remainder of the crew amounting to twenty-five, sailed for Tubouai, near Tahiti, in order to found a colony. Meeting opposition from the natives, whose rights the sailors had outraged, he repaired to Tahiti where the mutineers divided, eight going with Christian, the others preferring to remain at Tahiti to await the passing of a rare ship. Christian, who realized that if Bligh reached England, a man-of-war would be sent to recapture the mutineers, decided to make for an uninhabited island where he could escape the authorities. Accordingly he sailed for Pitcairn, which was then known to be deserted, having been discovered by a midshipman, a son of Major Pitcairn of Bunker Hill fame.

The foresight of Christian in seeking a remote and inaccessible island proved to be well grounded, since on the return of Bligh to England, he aroused strong public opinion unfavorable to the mutineers. The British Admiralty sent an expedition under the command of Captain Edwards to capture the mutineers.

NORFOLK ISLAND

Norfolk is about 1,000 miles northeast of Sydney, and about 3,000 miles west of Pitcairn

Those who had remained at Tahiti were eventually taken by Captain Edwards in the *Pandora,* which was wrecked in Torres Straits, the straits that Bligh had negotiated successfully. Edwards had confined the prisoners in the infamous "Pandora's box," a small structure built on the deck of the *Pandora.* During the confusion incident to the wreck, the men confined in the box were forgotten until one of the crew freed some of the prisoners, but several went down. Edwards and the men who were saved from the wreck finally reached Timor and shipped for England where he delivered the mutineers. They stood trial, and three were hanged, three pardoned, and the others who had survived were declared not guilty in the plot.

Pitcairn is a small island, roughly 4½ miles in circumference, and only about 1½ miles at its greatest diameter. The climate is very equable, ranging from 65 degrees to 85 degrees. Physically, the island rises abruptly from the ocean and is girt with precipitous cliffs, which make landing a difficult and hazardous process, and for this reason, the islanders were free from the attentions of passing ships and consequent embarrassing questions.

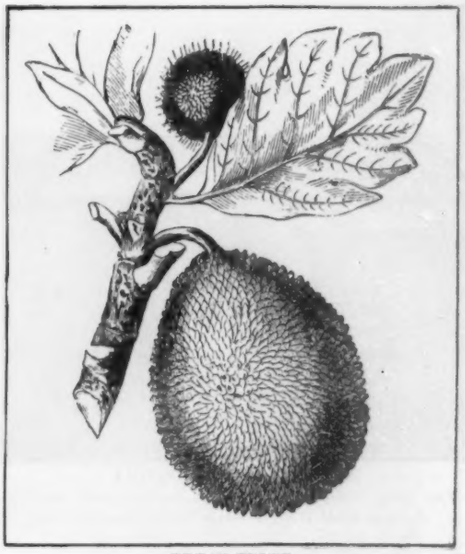
Christian and his party had taken twelve native women and six native men, and together they landed on Pitcairn where they destroyed the *Bounty*. From 1790, the year of their arrival at Pitcairn, until 1800 the island was the scene of horrible crimes. The native men, oppressed by their white masters, rebelled and killed several of the Englishmen. The white men with the aid of the Tahitian women retaliated by slaughtering the native men. Murders of indescribable brutality soon destroyed all but four of the Englishmen. Of the remaining men, McCoy drank himself to death from an intoxicating distillation of the Ti-root plant, and Quintal was murdered by Young and Adams since he threatened the lives of these two. In 1800 Young died of asthma, leaving Adams alone with several women and about twenty children. From this source, the Norfolk Islanders of today have descended.

Dawn of a New Era

A new period now began in the history of this interesting colony. Adams, becoming aware of his responsibilities and perhaps from remorse for his part in the preceding butchery, undertook to teach the young children the elements of Christianity, and so well had he succeeded that when the colony was discovered in 1808 by Captain Mayhew Folger of Boston and in 1814 by Staines and Pipon, these men gave glowing accounts of the intense religious atmosphere on Pitcairn and the simplicity and beauty of the life of its inhabitants. From this time on many ships called at Pitcairn and all the observers of the descendants of the mutineers were unanimous in their unstinted praise of the islanders. Brodie, who spent two weeks on the island in 1850, writes:

"And thus ends my brief stay among the most simple, innocent, and affectionate people it was ever my lot to be thrown amongst. There is a charm in perfect innocence which he must be indeed hackneyed and hardened who cannot feel. Such a society, so free, not only from vice, but even from those petty bickerings and jealousies—those minor infirmities which we are accustomed to suppose are ingrained in human nature—can probably not be paralleled elsewhere. It is the realization of Arcadia, or what we had been accustomed to suppose had existence only in poetic imagination—the golden age; all living as one family a commonwealth of brothers and sisters, which, indeed, by ties of relationship they actually are; the earth yielding abundantly, requiring only so much labor as suffices to support its occupants, and save them from the listlessness of inactivity: there is neither wealth nor want, but a primitive simplicity of life and manner, perfect equality in rank and station, and perfect content."

In 1856, the population having increased to about 190, the need for a larger island became imperative, and the entire colony was transported to Norfolk Island, a former penal settlement. In 1858 and again in 1863 several families returned to Pitcairn, but the main colony remained on Norfolk Island increasing to some 600, not including those who have migrated in recent years to New Zealand and Australia. The smaller group on Pitcairn now consists of 170-odd according to Sir Cecil Rodwell, who visited the island in 1921.



BREAD-FRUIT

A common source of food in Polynesia. The bread-fruit was the object of Bligh's voyage

It can easily be seen from the above paragraphs that the mutiny of the *Bounty* and the fortunes of the descendants of the mutineers had a strong hold on the imagination of a former generation to whom the idyllic and religious character of these people appealed. We today have a scientific interest in the Pitcairn and Norfolk Islanders. These people represent a cross between English and Polynesian, two rather widely divergent stocks, whose characters are sufficiently contrasting to allow a study of the physical results of race mixture. In addition to this, the descendants of the mutineers have for several generations been inbreeding, in some cases, very closely. One has, therefore, in these people a problem in human genetics which offers alluring possibilities. Then, too, they have been isolated on islands off the beaten tracks of commerce, having had little contact with the debasing influences, both sociological and psychological, which practically all other mixed people have had to suffer. They are under no social stigma such as that under which the mulattoes of this country and the Eurasians of India labor, a fact which makes their significance in a study of race mixture all the more important.

Fortunately I was enabled during part of the year 1923-24 to visit Norfolk Island as a Fellow of the

"UNCLE" CORNISH QUINTAL

Representing the second generation of descendants from the mutineers

NORFOLK ISLAND MAN

A common type of male to be found on Norfolk Island today

AN ISLAND GIRL

One of the few true blondes—a type recessive to the white strain

ANOTHER ISLAND GIRL

This type shows the predominance of the inherited Tahitian characters

A RELIC OF OLD NORFOLK

This house is one of the few remaining structures built in the days when Norfolk was a British penal colony

Bishop Museum and to make a study of the descendants of the mutineers, collecting data for an analysis of the genetic results of this cross between Tahitian women and English sailors. The island is situated on the extreme southern border of the tropics, about 1,000 miles northeast of Sydney, Australia. It is upward of twenty miles in circumference, being six miles at its greatest breadth. Resting on a submerged plateau and of volcanic origin, the island rises at its highest point to 1,000 feet above the sea. It is, however, for the most part, rolling park-like country with wide sweeps of open paddocks like lawns dotted with magnificent Norfolk Pines and frequently pierced with precipitous "gullies," at the bottoms of which flourish tall, damp banana trees in the midst of a typical jungle growth, all of which creates an illusion of a tropical swamp. Tall fern trees stand side by side with pines, and roses bloom in January. A long list, too tedious to recite in full, of exotic fruits grow luxuriously. Among these are the guava, passion-fruit, custard-apple, rose-apple, and paw-paw, besides many of the more common tropical fruits such as pineapple, orange and lemon.

In such surroundings the Norfolk Islanders live today, a more sophisticated people than they were in 1850. They have been so often represented as free from all the vices of more civilized races that it seems cruel to shatter such illusions, although the islanders themselves would be the last to claim such special characteristics. They have the passions and faults of other humans, but they still have, to a remarkable degree, a kindness of heart and hospitality which is refreshing. One feels a sheer joy in their giving, which unfortunately has to some extent been taken advantage of by a few tourists who are, however, in the minority. The religious tone which so impressed the early visitors is not so evident now, although the older folks still maintain their custom of frequent prayers and strict religious observances. But the young people pay less attention to religion than was formerly the case.

Physically, they are splendid examples of men and women, taller than either parent stock. They are, in the main, only slightly darker in complexion than a southern European, which darkness is due partly to constant exposure to the sun and partly to their Tahitian ancestresses. Some of the women, however, are as fair as the average American, and, indeed, there are even a few blondes who represent the recurrence of the English part of their ancestry. While most of the islanders have brown eyes, blue eyes are by no means uncommon.

Their Insularity Breaking Down

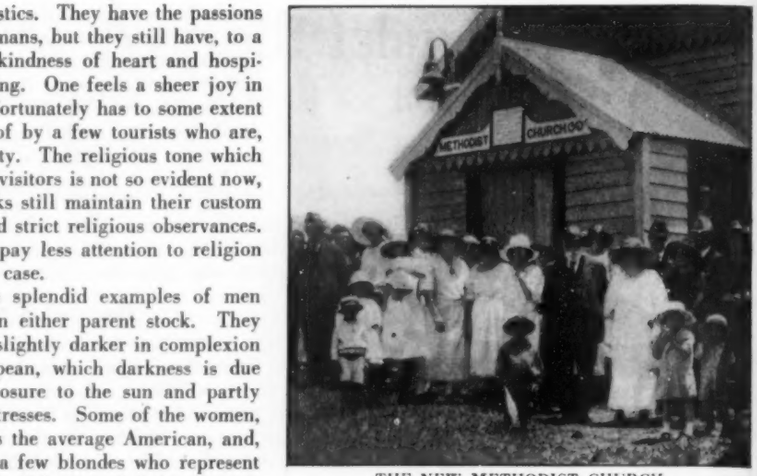
Farming is the principal industry, but they have had no success in the marketing of their products in Sydney, principally because of the distance to the mainland. Lemon juice was once and seems again likely to be a profitable source of income.

The most interesting and dangerous of their occupations is whaling, the mention of which brings me to a romantic phase of their history. Since the very early days of New Bedford whaling, the Pitcairn and later the Norfolk Islanders have had an intimate connection with the whalemen. For many years their principal trade was carried on with the whalers who frequently would stop and restock with fresh food and water. In the year 1846 as many as forty-six American ships touched at Pitcairn. But when the whaling from New Bedford declined, the islanders suffered because of lack of communication with the outside world and from a paucity of supplies, which they were accustomed to receive from the whalers in exchange for island products. Often a ship captain's wife would spend several months with the islanders to be picked up on the return trip, and from these visits the natives derived many of the old New England customs. Even to this day pie is still made in the New England manner.

When I arrived at Norfolk, many of the older men, including Uncle Cornish, who later became my guide and mentor, discovering that I was from Boston, plied me questions about their old friends from New Bedford. "Did I know Captains Chase and Church and Tabor and Bunker?" and a host of other names connected with New Bedford whaling. Some of the older men shipped with whalers, taking cruises of three and four years and ranging from the Bay of Islands to Behring Sea. I was particularly fortunate to prevail upon one of the crews to allow me to accompany them on a whale hunt.

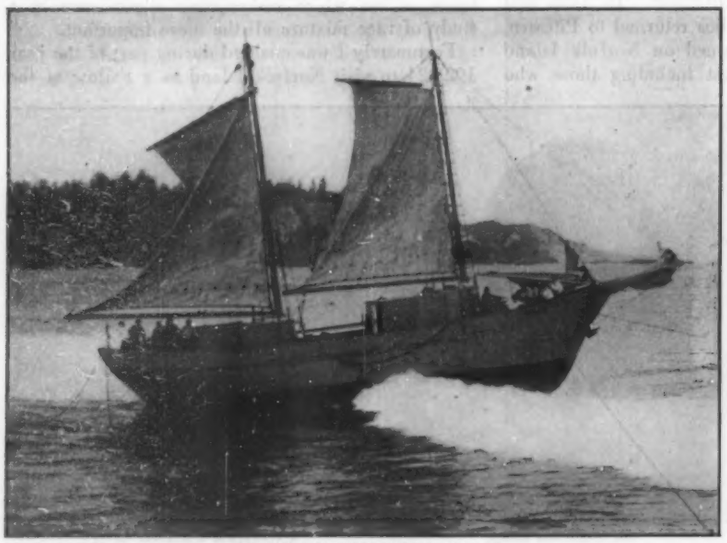
There are three whale-boats, about thirty feet long, on the island. Each of these is manned by a crew of six men and the whaling follows the best traditions of fifty and seventy-five years ago. There is the boat-steerer and the harpooner, who stands like the bronze statue in New Bedford, poised for the casting of the iron. The other four men pull on the oars or paddle as they approach the whale. The islanders are skillful boatmen and during the short season from July to September or October they manage, in a good run, to make a tidy bit in selling the whale oil.

Up to the present time the Norfolk Islanders have managed to maintain their insularity. But it seems that that will break down in the coming years, since the charm of the island is just beginning to attract visitors from Australia, and the opportunities in Sydney are very appealing to the young people who are increasingly leaving their island home.



THE NEW METHODIST CHURCH

A recent photograph showing the Methodist congregation at the dedication of their new place of worship

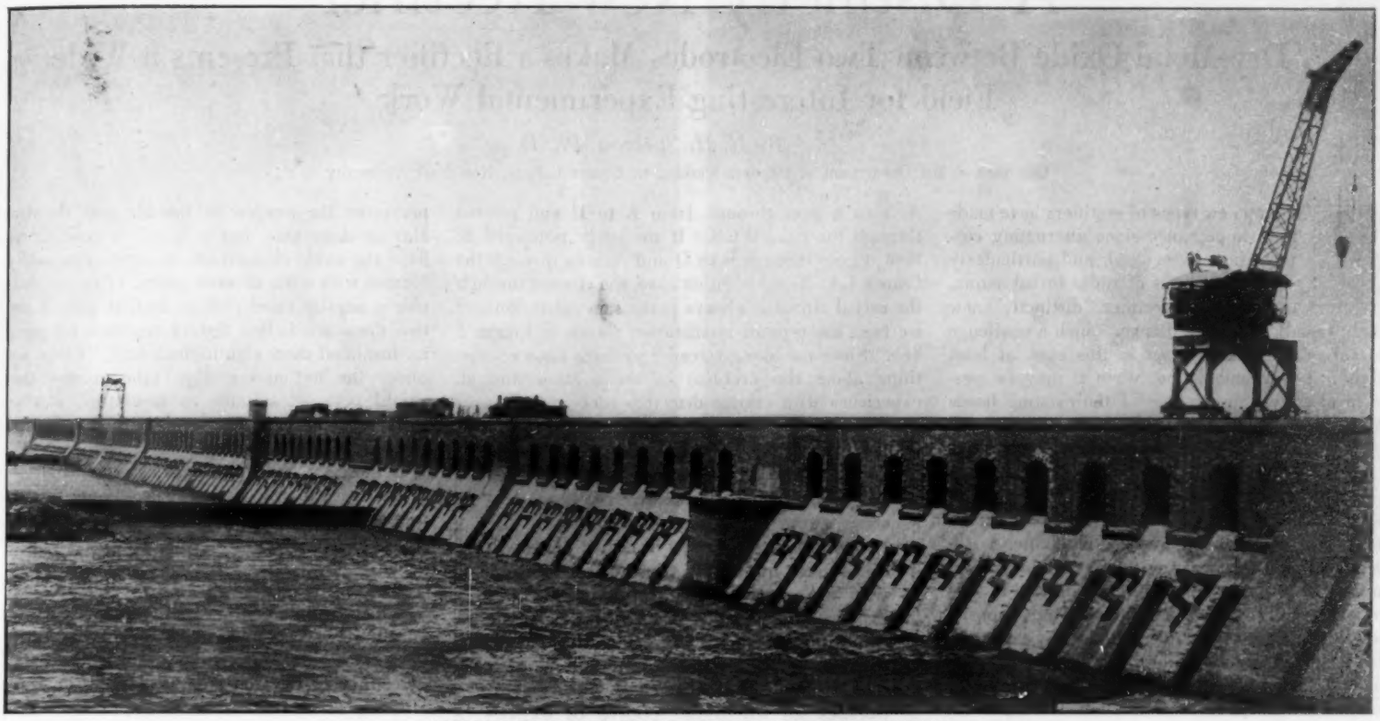


A RECENTLY COMPLETED BOAT

This was built by the Islanders for trading with New Zealand

A SOURCE OF INCOME

Whaling is one of the industries of the Norfolk Islanders



AFRICAN DAM WILL MAKE COTTON GROWING POSSIBLE

The granite Sennar Dam, recently built by the British across the Blue Nile, 170 miles south of Khartum, to irrigate 3,000,000 acres. This structure is 2.23 miles long, 128 feet high above the foundations, and is pierced by 80 large sluices and an upper line of spillway sluices

CONTRACTOR'S SUPPLY RAILWAY ON BRIDGE OF BOATS

The dam was built in two sections—one at a time. One half of the river bed was laid by building a temporary "sudd" or dam and unwatering the enclosed area by pumping. Access to the work was by a bridge of boats as here shown

Reclaiming Three Million Acres of "Darkest Africa"

We are all familiar with the great dam which the British built at Assouan for the irrigation of the valley of the Lower Nile—a work which has been largely responsible for the present material prosperity of Egypt. A few years ago, they conceived the project of reclaiming, by irrigation, a vast plateau that lies between the two forks of the Nile. The surveys showed that, by the construction of a dam across the Blue Nile at Sennar, it would be possible to store sufficient water for the irrigation, ultimately, of 3,000,000 acres of fertile, cotton-producing land, and immediately of 300,000 acres. The task of building this granite structure has been successfully accomplished under the supervision of O. L. Prowde and his staff.

A Distinctly New Rectifier

A Dry Metal Oxide Between Two Electrodes Makes a Rectifier that Presents a Wide Field for Interesting Experimental Work

By H. H. Sheldon, Ph. D.

Chairman of the Department of Physics, Washington Square College, New York University

SO many new types of rectifiers have made their appearance since alternating currents have been used, and particularly since the advent of radio broadcasting, that to call a rectifier "distinctly" new is likely to call forth a challenge. Such a challenge I am sure can be safely met in this case, at least until it is better understood, when it may be possible to classify it under one of the existing heads such as mechanical, chemical, thermionic, photoelectric, et cetera.

Building the Oxide Rectifier

Before discussing this rectifier, however, let us first get thoroughly in mind what a rectifier is intended to do. An alternating current is continually changing direction, rising to a maximum in one direction, falling to a maximum in the opposite direction and so on. Its fluctuations may be represented by a wavy line as shown in Figure 1 (a), the straight line through it indicating zero value of current. The purpose of a rectifier is to prevent the flow of a current in two directions by blocking it off in one direction or by changing one half of the wave so that both halves flow in the same direction, according to the type and construction of the instrument used. If a rectifier were ideal and permitted no reverse current whatever, the current obtained through the instrument when in series with a source of alternating current would be like that shown in Figure 1 (b). Here only half of the wave is used and we have a half-wave rectifier. A full wave rectifier would turn the lower half of the wave up, giving such a current as that shown in Figure 1 (c).

A convenient way of using this new rectifier as a full wave rectifier is shown in Figure 2. This requires that four of the rectifiers be arranged so that the normal current flows through them in the directions indicated by the arrows. If the surge is toward A, then it goes through from A to D and returns through the branch CB. If the surge is toward B, then it goes through B to D and returns through the branch CA. Thus, in either case, the current through the useful circuit is always in the same direction and we have the type of rectification shown in Figure 1 (c). Since the average reader perhaps knows something about the problem of rectification through experience with crystal detectors such as galena as used in radio sets, or perhaps with the more recent devices used in "A" battery chargers or "B" battery eliminators, I shall describe this new rectifier with particular emphasis on how it differs from others now used, in construction and in its action.

A Chance for the Amateur

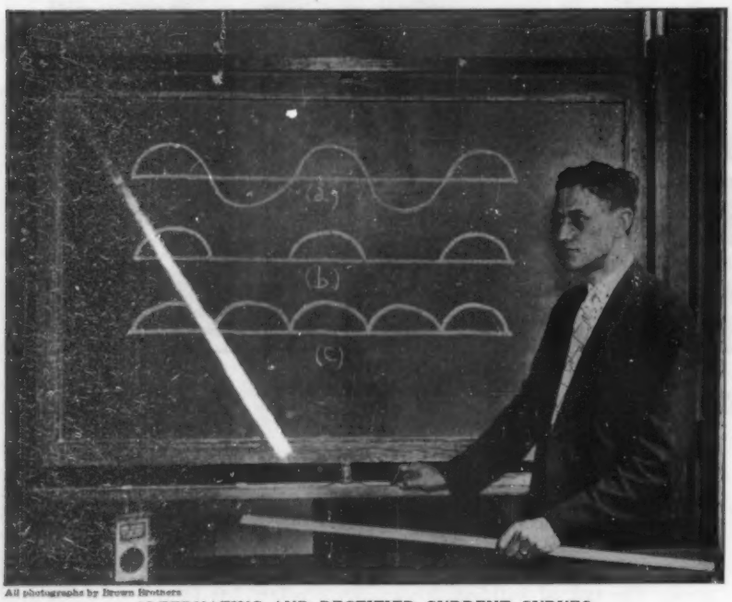
In this article, Professor Sheldon presents some enlightening details on the construction of a new rectifier that will be of great interest to those of our readers who are experimentally inclined. The instrument holds great possibilities in the direction of the further development of "A" battery eliminators for use in connection with radio sets. If the amateur pursues an intelligent course of experimentation, who can prophesy the final results? Since this rectifier will operate on low voltages, one problem of battery elimination is solved. It only remains to develop a working system. Why should not one of our readers accomplish this?

This rectifier, as described at a recent meeting of the American Physical Society by L. O. Grondahl, consists of a copper disk on which there is a layer of copper oxide. This oxide is formed right on the copper itself by heating the copper to a high temperature; the oxygen in the air will do the rest. Having done this, one side of the copper should have the oxide cleaned off, an operation easily performed with a file or sand paper. Against the other side a similar sized disk of lead is placed and the two discs are bolted tightly together by means of an insulated three-eighths inch bolt. Fibre washers under the nut and a fibre tube around the bolt would be most suitable as insulation, but several thicknesses of heavy paper will serve admirably if they are thick enough to resist tearing as the bolt is tightened. The whole unit as shown in Figure 3, is no larger than a watch. The sample rectifier exhibited at the American Physical Society was only 1½ inches in diameter.

Rectifies at Low Voltage

What will this rectifier do that others will not do? It will rectify a large current on a very little voltage; about three amperes on a volt and a half. For a rectifier of the diameter mentioned, its resistance will depend upon the pressure applied by screwing down the bolt and may be as small as a fraction of an ohm. For a lower resistance, and consequently a larger current, washers of a larger area are used. This large current at low voltage is the particularly striking feature of this rectifier. Crystal detectors are useful only for negligible current at high voltage; the rectifiers used in B battery eliminators use a high voltage of two to four hundred volts and pass a current of about forty to eighty milliamperes, roughly. Hot filament rectifiers such as the Rectigon or Tungar rectifying tubes, while passing a large current of a few amperes, nevertheless have the disadvantage of requiring current to heat the electron emitting filament. This greatly cuts down the efficiency. The new device does away with all of this loss, and is simple and extremely cheap to construct.

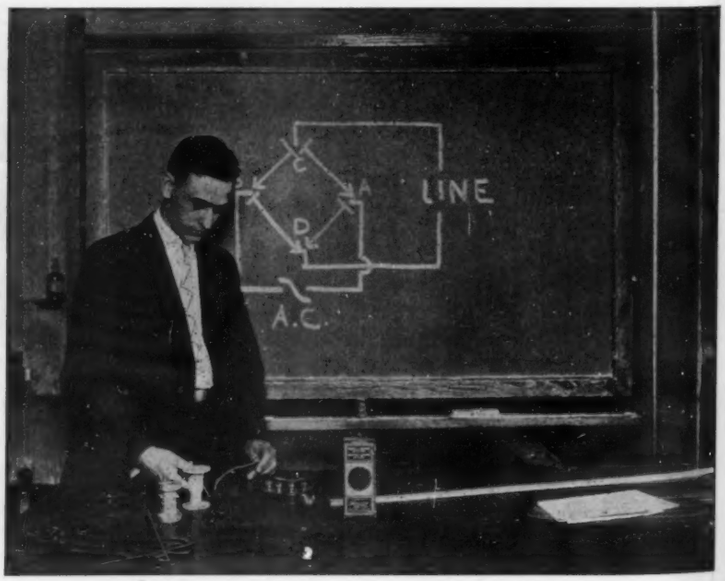
Such a device also has many new uses which the necessity of a heated filament prevents in the other



All photographs by Brown Brothers

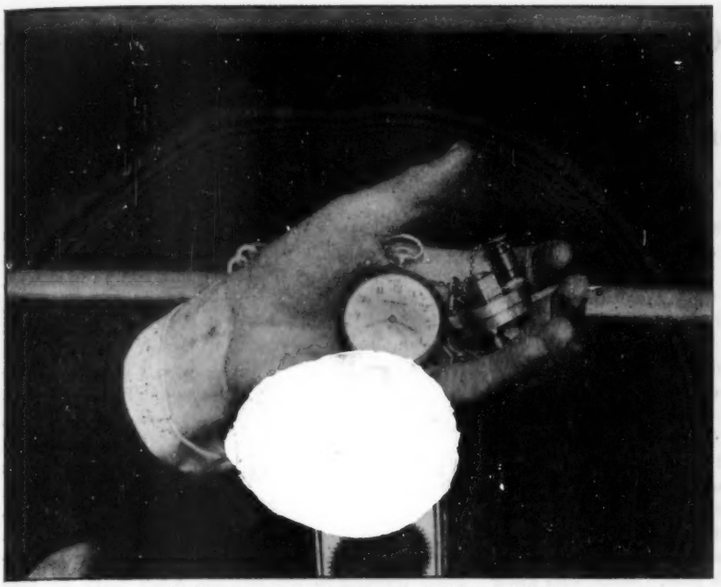
ALTERNATING AND RECTIFIED CURRENT CURVES

FIGURE 1: *The upper curve shows the variations of values for a non-rectified alternating current. The middle one shows half-wave and the lower one full-wave rectification*



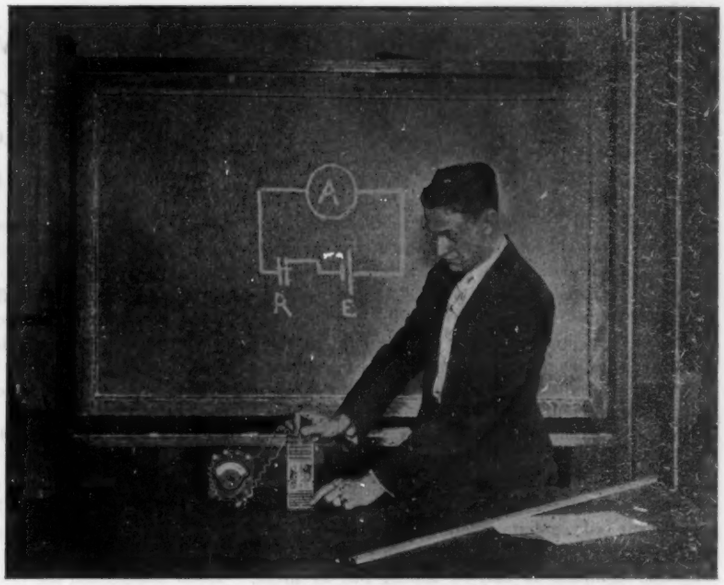
CONNECTIONS OF A BRIDGE RECTIFIER CIRCUIT

FIGURE 2: *To obtain full-wave rectification with rectifiers of the type described, four of them may be arranged and connected in a simple and efficient circuit as here shown*



ILLUSTRATING THE SIZE OF THE RECTIFIER

FIGURE 3: *Beside the watch is shown a home-made oxide rectifier. Its convenient size and low internal resistance are important features of this efficient instrument*



TESTING THE RECTIFIER'S ACTION

FIGURE 4: *For testing the rectifier, the simple arrangement shown above will suffice. A resistance may be necessary if the ammeter is taxed beyond its normal range*

types of high current rectifiers. One of these is to convert a direct current instrument into one for measuring alternating current values. To accomplish this it is only necessary to connect one of these new rectifiers in series with the instrument, for its low resistance is small compared to any circuit in which it might be inserted. Other uses, perhaps not so obvious, will probably occur to experimenters.

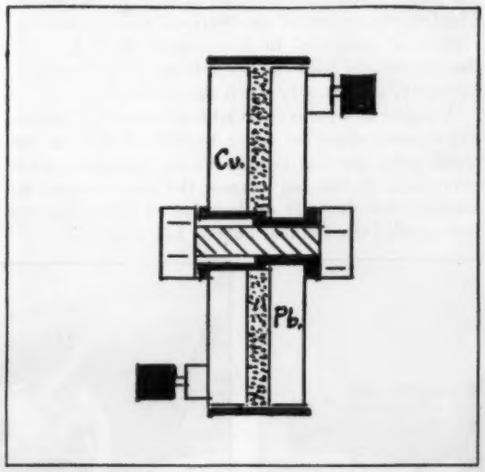
The purpose of this article is not to describe rectifiers with any great detail but rather to interest some of our readers in amateur research. I have described this rectifier as it was reported, as consisting of a copper washer oxidized on one side and a similar disk of lead fastened tightly to it by an insulated bolt. In the case of a similar rectifier seen elsewhere, however, the lead was replaced by a different metal and the oxide by another oxide. The latter was used in powdered form between the metals. This is shown in Figure 5.

Many Combinations Possible

If anyone knew exactly what takes place in a rectifier of this sort he could go at once to the materials which would be best suited to the purpose, but there is anything but agreement among those who attempt to explain this phenomenon. Here, then, is a chance for the amateur. The man who can bolt together the greatest number of materials, work with them under the widest range of pressures et cetera, will probably get the best results.

There are of course, some things which might guide the experimenter; one would not think of putting sawdust between iron on one side and glass on the other. What then, would be the sensible things to try? The success of the rectifier described above would suggest two metals, with an oxide of one of them between. It would be desirable however, to try other oxides as well. Since there seems to be some inherent difference between the metals in contact with the oxide, it would seem desirable to use metals as widely different, electrically, as possible. This would lead to the selection of metals far apart in the electromotive series. This series is a list of the metals so arranged that if any two are placed in a dilute acid and connected by a copper or other conducting wire outside of the liquid, a current will flow from the metal higher up in the table to the one lower down. Thus, if a copper strip and a zinc strip are placed in a dilute solution of sulphuric acid and connected with a conducting wire outside of the solution, a current will flow from the copper to the zinc. The copper is accordingly placed higher than zinc in the electromotive series. Such a series can be found in any elementary text on chemistry. It is noticeable however that the lead and copper used in the rectifier described are close together in this series, so that this may be the wrong key.

Since it is a rectifier that is desired, it might seem reasonable to use between the washers some crystal substance which has properties of rectification itself, or which has some other unusual electrical properties. There are many such. For example galena, which has been mentioned already, will rectify. If cut thin or powdered and put under pressure between plates its behavior might be greatly modified. Argentite, molybdenite and many other crystals are affected by light in such a manner that they will produce a small current under proper conditions. This is noticeable in nearly all silver sulphide crystals, so that here is another clew on which to work. Crystals of rochelle salts are remarkable for what is known as a "Piezo-electric" effect. When pressure is applied to such a crystal its opposite faces become charged electrically. These crystals are difficult to obtain as they do not occur naturally in sizes large enough to work with and so must be grown artificially. Crystals of selenium show a marked change in resistance with a change in intensity of illumination.



RECTIFIER CONSTRUCTION

FIGURE 5: *In this sectional view, the black portions represent insulating material, and the dotted part is the oxide*

None of these suggestions may be on the right track, yet the effects in each case have a certain earmark of similarity and suggest a possibility of success which an experimenter could not afford to neglect. The number of combinations which these suggestions would provide is very large and the likelihood of success is correspondingly high.

Testing Rectification

The question which remains to be answered has to do with the manner in which the experimenter is to determine the success of any particular rectifier which he may build. The ideal way would be, of course, to use an oscillograph. This is out of the question except in a well equipped laboratory, but for the purposes of development other methods will answer nearly as well. Since the voltage required is small, a single dry cell and an ammeter are all that are required, and as the ammeter is used only for purposes of comparison it does not need to be at all accurate. An ammeter such as is used in an automobile and which can be obtained very cheaply is perfectly satisfactory. To test the rectifier, place it in series with a battery and an ammeter (Figure 4), take the reading, then reverse the terminals on the rectifier and read again. The larger reading is usually called the "normal current" and the smaller is called the "reverse current." The smaller the reverse current in proportion to the normal current, the better is the rectifier. Such readings made with direct current may not be a fair test for a rectifier designed to be used on alternating current, yet it will give information on which to base a judgment of different rectifiers of the same type.

Besides the interest in the rectifiers themselves, it should be noticed that such a device as this, filling as it does an entirely new set of conditions, usually finds other special applications which were not previously known.

Taking this invention, then, as it is, without intention of improvement or change, perhaps the individual with some special interest may see a method of adapting it to his own purposes. Before attempting to market any such device, one should be careful to comply with any patent restrictions which may exist.

Are We Over the Pole?

How Byrd and Bennet Were Able to Answer This Question by the Aid of New Navigation Instruments

By Nell Ray Clarke

THERE is no big nail in the top of the world to tell where the meridians meet. The navigator of the air uses the same principles of spherical trigonometry in finding the pole that the navigator of the ocean uses in finding his port, except that the special conditions at the pole make his computations so simple that they can be made in advance.

The special conditions in the polar region require special navigation instruments and there are three which are absolutely essential to finding the pole when traveling in aircraft. The sun compass and drift indicator used together give the direction to go, and the bubble sextant tells the distance traveled and indicates when the pole has been reached. The magnetic compass is carried along, but in arctic aviation it cannot be depended upon.

As at the north pole our conception of north, south, east, and west becomes useless in describing direction, all directions being south, so at the north magnetic pole the directions indicated by the magnetic compass are useless. The force that in other parts of the world directs the needle, there only tends to point the needle straight down toward the ground. If the compass needle could be restricted to move only in a horizontal plane, this vertical magnetic force could have no effect to move it. But let its axis of rotation be inclined from the vertical position then this vertical magnetic force immediately becomes effective in turning the compass needle. The direction and amount that it turns is dependent on the direction and amount that its axis happens to be inclined.

As in an aircraft it is manifestly impossible to keep any instrument in a horizontal position, the magnetic compass is kept in a continual state of motion that makes it useless as a direction finding device. This is not only true at the magnetic pole but over a very large area surrounding it.

It must be understood too that in regions where the magnetic lines of force have a very steep angle of inclination, as they have near the magnetic pole, their horizontal components will be correspondingly weak. As it is this horizontal component only that has a desirable effect on the compass needle, the needle's direction is frequently dominated by the magnetism of the airplane and the vertical magnetic force just mentioned.

Even if all of these difficulties could be overcome, there would still be another. In what direction would the needle point in regions never before visited? How can anybody know? Nobody does know with a satisfactory degree of accuracy.

Compass Points a Crooked Path

If the poet who said "true as the needle to the pole" had known a little more about terrestrial magnetism, we would never have had that charming bit of fancy. The magnetic north pole is located on the Boothia Peninsula north of Hudson Bay and some 1,300 miles from the north pole. Many who know that the compass does not point toward the north pole believe that it points toward the north magnetic pole, but it does not do even that except once in a while. If one should start from anywhere in the world and go north as indicated by the compass he would eventually arrive at the north magnetic pole, but he would follow a decidedly crooked path to his destination. Only a little of the way would he be going directly toward the north pole. The direction that the compass points in any locality cannot be predicted. It can only be observed. That is why we have magnetic surveys and why navigators' charts are covered with lines showing the direction the compass points at different places on the seas.

If we have to abandon the familiar cardinal points in describing direction at the north pole and the magnetic compass too, as a direction indicating instrument, what can we substitute in their place? The sun compass invented by Albert H. Bumstead, Chief Cartographer of the National Geographic Society, and presented to Commander Byrd by that Society fulfills both these needs in a very satisfactory way, though only when the sun shines.

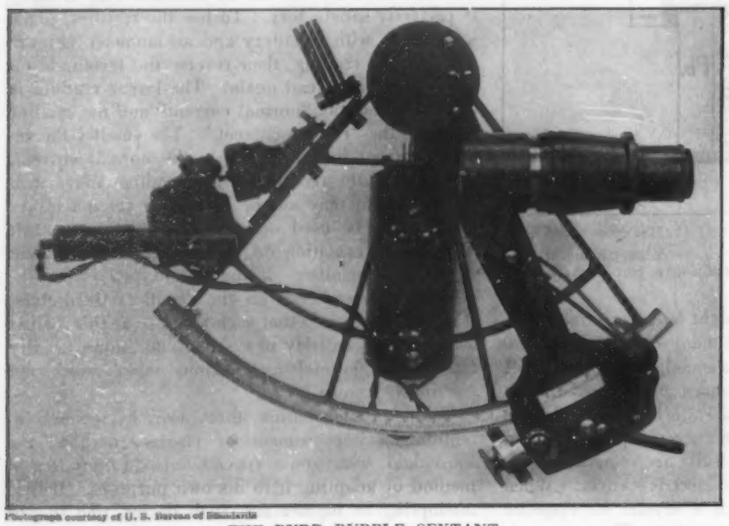
A glance at a polar chart with its meridians radiating in every direction and a thought of how, at the north pole, the sun circles the sky regularly once every day of summer suggest the sun compass so forcibly that the only explanation of its not having been made before is that nobody has wanted it.

Lay a polar chart on the table before you with the meridian that passes through your home town pointing south. Get out your watch and lay it, face up, directly over the north pole of the chart, with the XII mark over your own meridian. At noon the hour hand and the XII point of your watch and your meridian on the map will be all together and pointing south toward the sun. Transport yourself in imagination to the pole and think what the sun is going to do as the day advances. By 6 PM it will have made one quarter of the circuit of the sky and will be opposite the III o'clock mark on your watch. If your watch could be regulated to go at just half speed, the hour hand would exactly follow the sun around the dial and so long as the hour hand pointed to the sun the noon mark on your watch would point in the direction of your meridian. That would be a perfectly definite direction for regions near the pole, although whether or not it would be south would depend on whether or not one was on the meridian for which the watch was set.

The Bumstead sun compass makes use of this simple relation between sun and time and direction. It consists of a clock regulated to move a single hand once around in twenty-four hours. The clock face has hour divisions and ten-minute divisions. The clock is mounted on horizontal trunnions above a compass dial. The compass dial is marked in the usual way with the cardinal points and with degrees.

The trunnions permit the clock to be inclined at any angle with reference to the compass dial; but as the trunnions are parallel to the 6 AM and 6 PM divisions on the clock and to the east and west divisions on the compass dial, the noon and midnight markings of the clock are always in the vertical plane passing through the north and south marks of the compass dial.

This arrangement of mounting the clock permits of its being made parallel to the horizontal position it would have if laid flat at the pole. This is necessary, as in no other position would the hand exactly follow the sun. To give the clock this parallelism it must be tipped from the horizontal position through the same number of degrees as there are degrees of latitude between the location where the



Photograph courtesy of U. S. Bureau of Standards

THE BYRD BUBBLE SEXTANT

This instrument provides an artificial horizon, making its use in an airplane possible

Photograph by L. R. Ross

BYRD'S POLAR AIRPLANE

The three air-cooled engines as well as the operating cockpit are plainly visible

NAVIGATOR AND INVENTOR

Byrd, left, and Bumstead, inventor of the sun compass, checking one of the instruments

Photograph courtesy of U. S. Naval Air Station

A GREENLAND ICE FIELD

This photograph gives some idea of the terrain over which Byrd had to fly to the pole

sun compass is being used and the pole. A vertical arc is provided for making this setting, and it is merely necessary to incline the clock so that the latitude is read on this arc.

The hand of the clock is provided with a vertical shadow pin or gnomon which, in the sun's rays, casts a shadow along the hand, enabling the pointing of the hand toward the sun to be made accurately.

As the changing declination of the sun only changes the position of the end of the shadow along the clock hand, but does not move it from side to side, it is not necessary to take account of the sun's declination. This is a very important simplification of the methods for checking the compass known to every navigator.

Measuring the Airplane's Drift

The compass dial can be turned on its base and any desired heading set opposite a lubber-line just as in a mariner's compass. The difference in use is that in the mariner's compass the lubber-line is kept opposite the proper division of the dial by movement of the steering mechanism, while with the sun compass the sun's shadow is kept on the clock hand by movement of the steering mechanism.

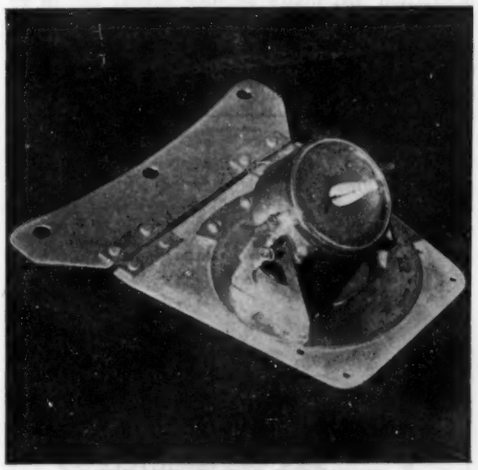
The sun compass was the instrument used by Commander Byrd to indicate the direction of the meridian along which he wished to fly. He knew that if he could accurately follow that meridian he would pass over the north pole. But heading his plane north is no assurance that it is going to travel north. There are winds in the arctic as elsewhere and a plane's motion over the ground is the resultant of the motion of the air and the motion of the plane through the air. In a trap door in the bottom of the plane is a drift indicator. It consists of a window on which is a single line. This line can be turned horizontally into such a position that objects on the ground appear to move along it without crossing it. When it is so set it points in the direction the plane is moving with reference to the ground. The drift indicator is provided with an arc that shows the number of degrees between the heading of the plane and the direction of its motion. This same number of degrees has to be set off on the dial of the sun compass in order to keep the plane actually moving north.

On the skill of the navigator in the use of these two instruments and of the pilot in handling the plane depends the success of flying over the pole.

We have one more question. How does he know when he gets there?

The horizon at the pole is a plane parallel to the plane of the earth's equator. The sun's rays make almost exactly the same angle with one of these planes as with the other. This angle is called the "sun's declination." It is a continually changing angle, but its amount at any time is tabulated in the nautical almanac. The sun's rays are bent somewhat in passing through the earth's atmosphere, but the amount of this refraction is well known.

So a table can be prepared in advance giving the angular height above the polar horizon of the sun at any given time. The sun will be at the same height at that time all along a line (called a "Sumner line") at right angles to the sun's rays, but nowhere else. The polar navigator must time his flight to arrive at the pole at a time when the Sumner line cuts the meridian on which he has flown at a



THE BUMSTEAD SUN COMPASS

All of the important parts and graduated circles are shown

blunt angle, as it is the intersection of the Sumner line and the meridian that locates the pole. The best time for him to arrive at the pole would be when the sun was directly ahead or directly behind him. If the sun were at right angles to his line of flight he could not know when he arrived at the pole because his change of position would not make any change in the angle of elevation of the sun.

Commander Byrd arrived at the pole at 9:04 AM, Greenwich time, when the sun was about 33 degrees from his line of flight which, while not the best position, was very good.

Now the measuring of the sun's angle of elevation calls for a third instrument. Every navigator uses the sextant for this very purpose and is wholly dependent on it for knowing his latitude and longitude at sea. In the sextant, the line of vision is split by mirrors so that the sun can be made to appear to just touch the sea horizon. Hence the expression "bringing down the sun." When the sun is "brought down" by the sextant, an angle is read off from the limb of the sextant which with two or three known corrections is the sun's altitude.

The navigator of the air cannot use the ordinary mariner's sextant because his horizon is too distant and too indistinct and too much displaced on account of his height above the surface.

Reasonable Errors not Objectionable

Commander Byrd devised the bubble sextant in which a spirit level replaces the sea horizon. In it too, the line of vision is split so that in "bringing down the sun," the sun appears to be just centered about the bubble of the level. When Commander Byrd knew by the time he had been flying that he should be approaching the pole, he measured the sun's altitude with the bubble sextant. The readings became smaller and smaller as he went along and, when they reached the value that he had tabulated for the pole for the particular time, he knew he was there. Exact readings of altitude from a moving airplane cannot be made and it would be unreasonable to ask an aviator going at a speed of a mile and a half a minute to take an observation at the exact instant at which he passed over the pole or to say at just what moment he arrived there. If he has covered the ground and knows within ten minutes his time or within fifteen miles his position he has done all that reasonably can be asked. If he could land and make more careful observations from the surface, he would know within smaller limits, but there still would be a range of uncertainty. All measurements are subject to errors, even when made with the greatest skill and under the most favorable conditions, but when the errors are reasonably small and do not detract from the value of the result, we do not object to them.

So, while a possible 15-mile error could not be tolerated in a ship's position entering a harbor in a fog, it would be quite satisfactory for all intents and purposes for an aviator's location of the north pole.

The fact that Commander Byrd was able to turn about and retrace his steps, so to speak, without a single landmark, and, after being in the air about 15 hours and flying 1,500 miles, to arrive at Kings Bay is in itself a spectacular example of accurate navigation and the strongest possible evidence that he knew pretty well where he was all the while.

AN ATTRACTIVE LIVE ORNAMENT MAY BE MADE FROM A PLANT, AN OLD ELECTRIC LIGHT BULB, A THISTLE TUBE AND A PAPER WEIGHT ASSEMBLED AS ABOVE

Plants Grow in Air-tight Containers

The Balanced Processes of Green Plants Enable Them to Live Almost Indefinitely in an Hermetically Sealed System

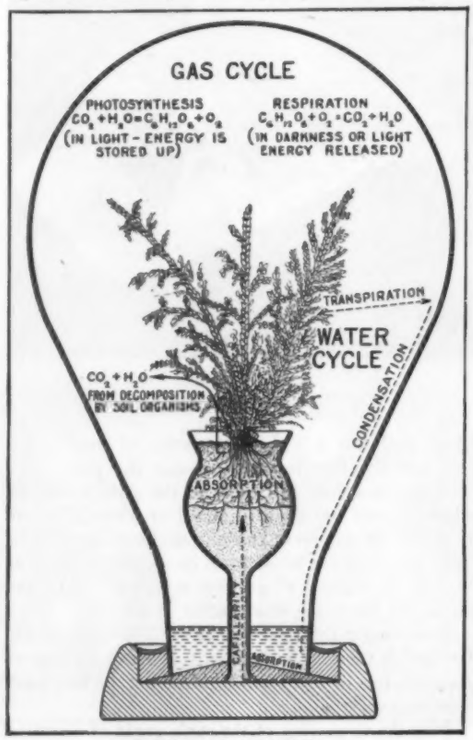
By Raymond H. Wallace
Fellow in Botany, Columbia University

ALL forms of life are characterized by their ability to adapt themselves to a greater or lesser extent to their environment in a manner most advantageous to themselves. It would seem almost impossible, however, for a living organism to be so constituted that its processes would enable it to live and grow in an hermetically sealed system; that is, isolated from all external factors except light and heat. Some green plants have this ability, however, and can live for long periods of time in such a chamber.

All living organisms take in food materials and excrete waste products. Hence, in order that an organism may survive for any length of time in a closed system, its vital processes must be cyclic so that no essential substance becomes unavailable or exhausted. It is plainly evident that an animal could live such a confined existence for only a very brief period, since it must be supplied with a source of energy, such as food, and the oxygen supply must be continually replenished; otherwise it would be suffocated by the products of its own respiration.

How Plants "Breathe"

It has long been known that green plants carry on two processes which fact makes it theoretically possible for them to live for long periods of time hermetically sealed. One process is respiration, by which plants break down stored food in the same manner as do animals, although usually at a much slower rate. The other process is photosynthesis, or the assimilation of carbon dioxide and water to form food. Since photosynthesis is the more vigorous reaction, being in some cases more than forty times as rapid in terms of gas exchange as is the respiration in the same individual, plants are able to accumulate a surplus of organic products such as carbohydrates, fats, et cetera. It is this excess in the plant world of food manufacture over food destruction that makes possible animal life in its various forms. During photosynthesis, oxygen is continually given off, and it is this established fact that has probably given rise to the erroneous conception, commonly held by laymen, that plants "breathe" in only carbon dioxide and give off oxygen.



THE UNIT CYCLE
This is maintained only by certain kinds of plants

A comparison of the chemical reactions occurring in the processes of respiration and photosynthesis will show how it is possible for some plants to adjust their gas relation so that they can live in a small closed chamber. In simple terms, respiration may be expressed as follows: Carbohydrate plus oxygen forms carbon dioxide and water; energy being released. Reverse the formula, as follows: Carbon dioxide plus water, in the presence of light, forms carbohydrate and oxygen, energy being stored in the form of food, and we have the simplified formula for photosynthesis. If the volume of carbon dioxide evolved in respiration should equal the volume of oxygen evolved in photosynthesis, the photosynthesis-respiration ratio would be unity and the gas pressure would remain constant.

Effect of Darkness and Light

The process of respiration is a very general reaction, occurring in all living organisms at all times; but the process of photosynthesis is more restricted, occurring only in green plants in the presence of carbon dioxide, water, and light. A plant respires at all times, but in sunlight it quickly converts the carbon dioxide present into carbohydrate by the energy of light and may thus maintain the food and oxygen cycle, even when in a closed container. In darkness, the partial pressure of oxygen is gradually reduced by the respiration of the plant and carbon dioxide replaces it, but in the presence of light the reverse process of photosynthesis occurs and the partial pressure of carbon dioxide is quickly reduced to practically zero with the result that the partial pressure of the oxygen is re-established to its former value.

Even though the theoretical possibilities of a green plant living in a closed system appear so favorable, it seems never to have been thoroughly

established experimentally. However, it is quite commonly known in botanical circles that algae, such as pond scums, or algae and a small fish, can live in bottles of water which are almost, if not entirely, hermetically sealed. Also one case is reported in which a volunteer fern has grown for years in a sealed soil sample, but apparently no attempt was made to extend the observations further.

It sometimes happens in experimental work that a failure to follow the standard technique of an experiment may lead to interesting results of a nature entirely different from those for which the experiment was designed. The method here described of growing plants in sealed containers is of that nature, being the outgrowth of an observation made in connection with some experiments as to the effect of illuminating gas on plants.

Chance Led to Discovery

In these experiments various plants were placed in inverted bell-jars sealed by means of ground glass plates and vaseline. Circumstances prevented the dismantling of the apparatus at the end of the usual period of ten days or two weeks and the plants were left sealed. At the end of a month all were green and growing, apparently none the worse for their enforced seclusion. It then seemed interesting to determine how long they would continue to live and grow, so the plants were left unmolested. At the end of seven months they were still vigorous and healthy. How much longer they would have continued was not established, because the jars were accidently broken open. This incident suggested that if big plants would grow in big containers, little ones should grow in little containers.

The apparatus here illustrated was thereupon devised. It consists of three principal parts: a bulb, a base, and a plant container which in this case is a thistle tube. The plant is potted in soil, and the apparatus is then hermetically sealed at the base. A quantity of water suitable for the type of plant being tested is included in the apparatus before sealing. The "set-up" now requires no further attention except to allow it to stand in adequate light for a part of each day.

An important consideration aside from the gas cycle of respiration and photosynthesis is the water

A TOBACCO PLANT
This will thrive vigorously when left in sunlight

cycle of the plant. This also must be automatic; otherwise the plant would die from lack of moisture in the soil. Plants do not seem to have the ability to take water from the air even though the atmosphere be saturated. In bulbs such as described, water that has evaporated from the soil and plant condenses on the walls of the bulb and runs down to the base where it is absorbed by the porous plaster of Paris. It then rises by capillarity into the soil around the roots of the plant and is there absorbed. Thus it again becomes available for evaporation.

The balance in the gas cycle and water cycle explains how a green plant can live in a closed system. But how can it increase in size? The answer is suggested by a simple biological fact. Humus, such as leaf mould, is at all times being decomposed by microscopic soil organisms to form carbon dioxide and water. In this manner, by potting a plant in a rich humus-containing soil, the plant is constantly receiving a slightly greater amount of carbon dioxide than just that derived from its own respiration. This additional amount can be utilized in growth.

Fatal to Some Species

Growth is evidenced in some plants simply by the development of additional foliage, but in others there is an interesting cyclic phenomenon in the death of old leaves and the development of new ones to replace them. This is especially true of ferns. This cyclic replacement of leaves seems to be a survival of the fittest, the younger tissues being more vigorous and full of vitality and therefore able to supersede the older, less active members.

Many species of plants can not survive for any great length of time when hermetically sealed in this way. Among thirty species so far tested, less than fifty percent seem able to adapt and maintain themselves in such an environment. Failure to survive may be due to the plants maintaining a photosynthesis-respiration ratio which is other than unity. In this case death may result from auto-asphyxiation or starvation, depending upon whether the oxygen or the carbon dioxide is the gas exhausted. The saturated atmosphere inside the bulb may cause the death of some species, since observations have shown that some plants die or at least become pathological when grown in a saturated atmosphere. Environmental conditions inside the bulbs are particularly favorable for many forms of bacteria and fungi, and if pathogenic forms are present when the apparatus is sealed, they very often bring about the death of the enclosed plant.

Plants are often classified as sun or shade plants, depending upon the light conditions under which they grow best, and it has been found that the two types react differently in these chambers. A sun plant, such as tobacco, can live for only a few days unless it is given strong diffused light; while a fern or club moss will die under the same treatment, but thrive when kept in weak diffused light. Sun plants as a class are rather unsatisfactory for these chambers, since the heat that accompanies the greater light intensity is imprisoned by the bulb and tends to injure the plant.

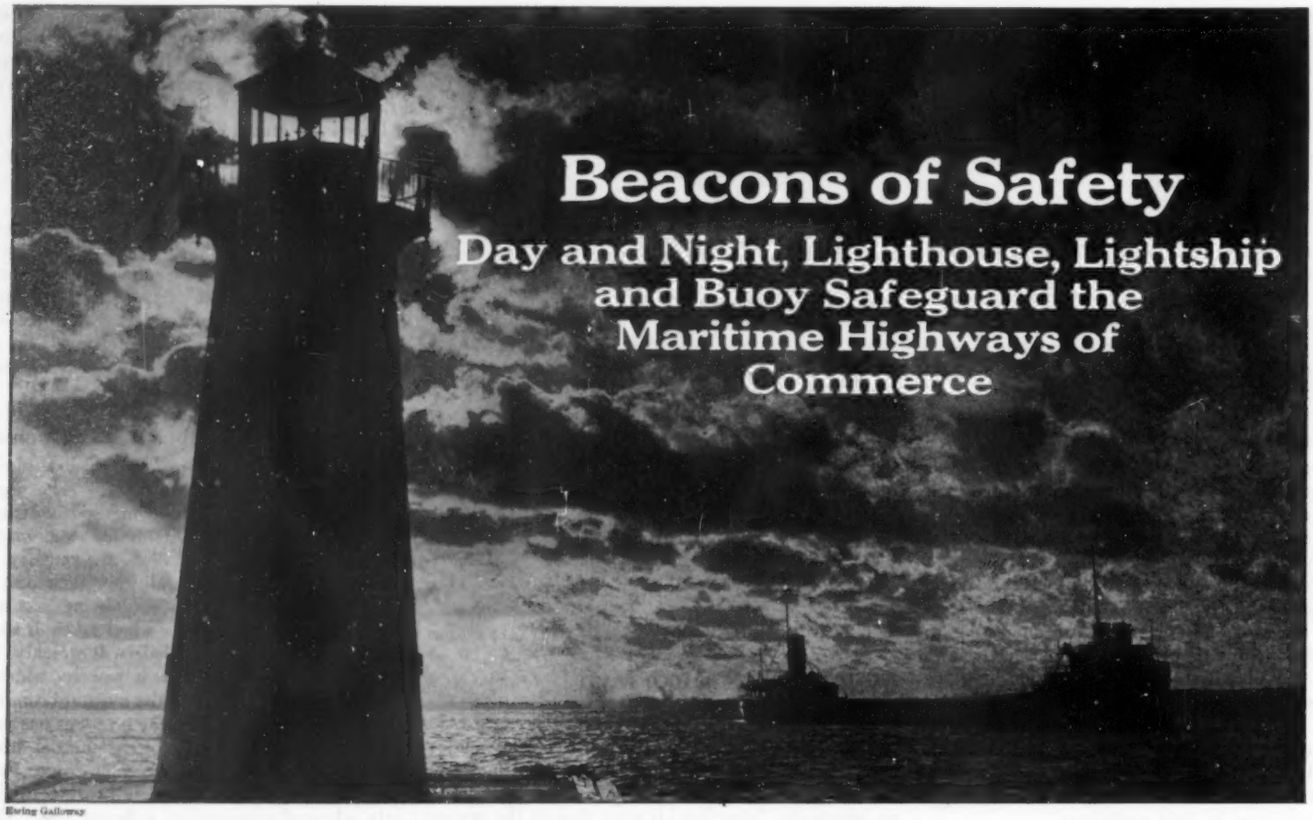
Plants More Adaptable than Animals

The ability of a plant to survive in a closed system seems to bear no relation to its evolutionary position in the plant kingdom; species from club mosses to flowering plants have been tested with successful results. Plants which normally require a rather high relative humidity for their best growth seem to do better than those growing best in a dry atmosphere. Many plants when taken from greenhouse conditions and sealed, will quickly lose all their leaves and then grow a new set which is apparently better adjusted to the moisture conditions in the new environment. So far no plant has produced viable seed, thus completing its normal life cycle. There is, however, no theoretic impossibility of demonstrating such a complete life cycle in a properly adjusted container of sufficient size. This suggests an interesting series of experiments.

These green plants living and growing in hermetically sealed containers give an interesting demonstration of the cyclic processes occurring in some organisms. Also the enclosed plants in their form and appearances show excellent examples of the adaption of organisms to their environment. The theory that plant life preceded animal life in its appearance upon the earth is held by many scientists and this ability of green plants to live the confined existence told of here demonstrates the definite possibility that this could have been the case.

THE CLUB MOSS
Such plants must be kept from sunlight as in nature

SENSITIVE PLANT
Some plants will fold up when the glass is jarred



Beacons of Safety

Day and Night, Lighthouse, Lightship and Buoy Safeguard the Maritime Highways of Commerce

Ewing Galloway

APART from its inestimable value to maritime commerce, the lighthouse service makes a strong sentimental and even dramatic appeal to those of us who have occasion to go down to the sea in ships. The brilliant, far-flung shaft of light from some towering lighthouse and the twinkling light from some channel buoy are alike the trusted friend of the voyager—none more eagerly watched for and none more warmly welcomed.

At the time of the organization of the United States Government, there were ten lighthouses owned and operated by the colonies. These had been built between 1716 and 1789 when Portsmouth Harbor Light was erected. Five other lighthouses were under construction by the colonies, and Virginia had gathered materials for a lighthouse at Cape Henry. It is of interest to note that of these 16 light stations, all are in operation today.

A 40,580 Mile Coast to Guard

The institution of a fog-signal system dates from 1719 when a large gun was installed at the Boston Light, "to answer ships in a fog," and this gun, which bears the date 1700, can still be seen at Boston Light Station. Boston Light was burned by the Americans more than once during the war and repaired by the British, who, however, on evacuation, blew up the light. For seven years thereafter, there was no light shown; but in 1783, the legislature rebuilt the light on the original lines.

The United States Lighthouse Service "is charged with the establishment and maintenance of aids to navigation." Its executive office is in Washington, D. C., under the Commissioner of Lighthouses, George R. Putnam. The service is divided into 19 lighthouse districts, and the force is composed of civilians, except in the three river districts, which are in charge of officers of the United States Corps of Engineers. One or more lighthouse depots in each district serve for the storage and distribution of supplies and apparatus. Also, on Staten Island, New York Harbor, is a general lighthouse depot, where many supplies for the whole service are stored and sent out for distribution, and much technical work in the way of testing apparatus and supplies is carried on. Each district is provided with a lighthouse tender.

The jurisdiction of the lighthouse service covers the Atlantic, Gulf, Great Lakes and Pacific Coast, the principal interior rivers, Alaska, Porto Rico and Hawaii and all other territory under the jurisdiction of the United States. The Philippine Islands provide their own lighthouse service, and the lighting of the Panama Canal and its approaches is under the care and supervision of the federal government.

AN HAWAIIAN LIGHTHOUSE
Situated on Kauai Island, it is 216 feet above sea level

The total length of coastline thus served totals 40,580 statute miles, and to safeguard this great stretch of our shores calls for a total of 16,373 aids to navigation, of which 5,799 are lighted and 10,574 are unlighted. Under the heading of "lighted" are the main lights, minor lights, light vessels, gas buoys and float lights. Under the head of "unlighted aids" are fog signals, radio fog signals, submarine signals, whistling buoys, bell buoys, other miscellaneous buoys and day beacons.

The term "minor light" includes post lights and small lights generally not attended by resident keepers but looked after by persons living in the vicinity. Light vessels are used as a rule to mark off-shore dangers or approaches to harbors where the building of a lighthouse is not practicable or economical. Gas buoys mark important channels or shoals and act as general guides for navigation. Float lights are small lights carried on a float or raft and they are used at the less important places.

Buoys and Spars Most Numerous

Fog signals include various types of air and submarine sound-producing apparatus and radio signals for thick weather. Radio fog signals are low-powered radio stations, sending automatic signals from lighthouse or lightship, which are received by radio compasses on the ship and enable navigators to obtain their bearings. Submarine signals are auxiliary fog signals, which are sent out from bells operated under water. They are usually placed on light vessels. Whistling and bell buoys are operated by the motion of the buoy in the sea.

The most extensively used of all aids to navigation are buoys and spars of various types. Day beacons include minor fixed structures which do not carry a light, the most common being a post or spindle bearing a target of distinctive shape and color.

It is of interest just here to record the total number of principal light stations, light vessels and fog signals throughout the world. These, however, do

not include the Great Lakes of North America nor rivers beyond the limit of sea-going navigation.

Continents	*Light Stations*	*Light Vessels*	*Fog Signals*
Europe	7,428	167	806
North America	3,085	47	696
Asia	1,532	38	122
Australia and Oceania	755	3	23
Africa	622	1	13
South America	398	7	17
Total	13,820	263	1,677

The lighthouse proper is an attended light where resident keepers are employed, and the types of these vary greatly. The common form for harbor or lake lights is a combined tower and dwelling of timber or brick construction. For the more important lights, the tower is separate from the dwelling and generally is of fireproof construction. The towers of this type are of masonry with stairways, lantern, et cetera, of cast iron. Those of a more recent type are built upon a structural framework of wrought iron or steel with an enclosed stairway in the center. The latest development is seen in the modern reinforced-concrete towers which are now standard.

Evolution of Our Modern Lighthouses

Complete equipment of a light station on land consists of the light tower, oil house, fog signal building, keeper's dwellings, workshop, water supply and drainage system, landing wharf, boathouses, barn and other structures. Where there is no convenient projecting peninsula or island or rock to carry a lighthouse, some difficult engineering work frequently has to be done. In some cases, a massive cofferdam is sunk through the overlying sand or mud until a firm foundation of rock or suitable bearing material is reached and upon this is built the concrete or masonry structure. Elsewhere, circular steel cylinders are sunk, dredged out and then filled with concrete. In other cases, as on the Great Lakes, cribs filled with stone are placed on the bottom and capped with concrete or other masonry. Many lighthouses are built on the ends of breakwaters or pierheads at the entrance to harbors—the existing structure being used as a support, and strengthened to provide a sure foundation and avoid vibration.

The height of the towers is determined by the nature of the shore and the importance of the light. On the Atlantic Coast where the shore is low, tall towers are required. On the more lofty shores of the Pacific, low towers on prominent headlands suffice. The tallest tower, at Cape Hatteras, is 193 feet high. Cape Charles 191 feet, Cape May 170 feet, Fire Island 167 feet, and Cape Henry 165 feet are some of the tallest of our lighthouses.

ON A CALIFORNIAN BREAKWATER

This harbor lighthouse has a beacon of 67,000 candle power

The earliest lighting apparatus consisted of an open coal, wood, or pitch fire burned on the top of the tower. The first Boston light used the customary oil burner of the period, the illuminant being fish or whale oil. By 1812, sperm oil, burned in a lamp on the Argand principal was in general use. By 1840, the bull's-eye "magnifiers" had given place to reflectors, paraboloid in form and heavily silvered. Then came the Fresnel lens which is built up of glass prisms in panels—the advantage of which consisted in the greater brilliancy and the fact that a large proportion of the light is concentrated into powerful beams useful to the mariner. Kerosene came into use in 1877 and it ultimately became the principal illuminant—the present form consisting of a concentric wick using five wicks for the largest sizes. The latest and most important lights burn vaporized kerosene under an incandescent mantle. Acetylene and oil gas are used for lighted buoys, unattended lighted beacons, et cetera. One of these, located in Molokini Island, Hawaii, has burned continuously night and day since it was installed in 1911.

The lights on a properly marked coast should be so close that a vessel approaching land will always be in sight of at least one light, and this condition is met on our north Atlantic seaboard. To avoid confusion between lights, they are given distinct characteristics and the more important now carry flashing or occulting lights—the effect being produced by revolving the lens or by some form of moving shutter which shuts out the light at intervals, the motion being regulated by clockwork.

A Beam of 712,000 Candle Power

The range of the light is determined by its height above sea and its power. The highest light is at Cape Mendocino, 422 feet above high water, with a range of about 28 miles. The strength of illumination is measured in candle power—the most powerful light in this country being at Navesink, New Jersey, which throws a beam of 712,000 candle power.

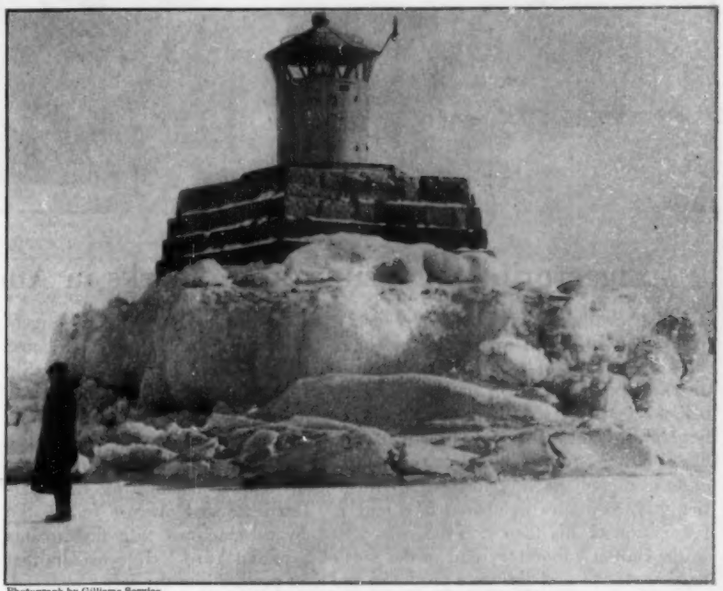
In case of fog, the work of the lighthouse is taken up by the fog siren, which may be described as a powerful whistle and horn operated intermittently by steam or compressed air.

The lighthouse service maintains light vessels at 49 stations. They are generally employed for marking dangers at sea, approaches to harbors and important points in the courses of vessels, in locations where a lighthouse could not be built. Their equipment consists of powerful lights at the mast head, sirens and submarine bells. Since they must stay out in all weathers, they are stoutly built with a high freeboard and heavy moorings. Careful provision is made for the comfort of the crew, which consists in a first-class vessel of four or five officers and ten or eleven men. Although the work of the service is primarily concerned with the maintenance of aids to navigation, the records of the service are replete with many heroic rescues of persons or vessels in distress—the annual report for 1921 recording 125 occasions in which salvage of life or property was rendered by employes of the lighthouse service.

Photograph by P. & A. Photos

THE OLD AND THE NEW

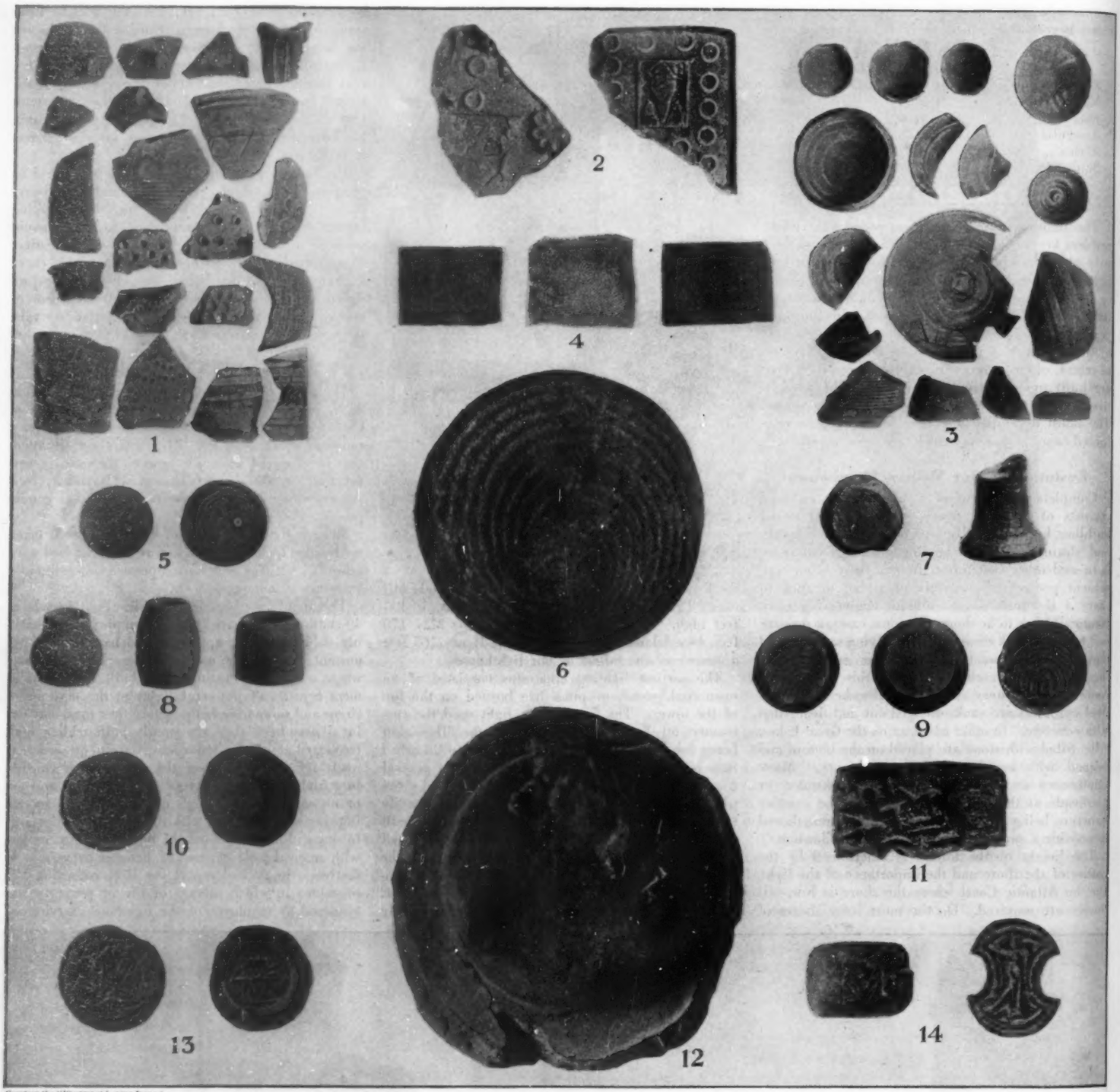
The newer Eddystone lighthouse at Plymouth is shown to the left of the old tower



Photograph by Gilliams Service

AN AUTOMATICALLY OPERATED WARNING

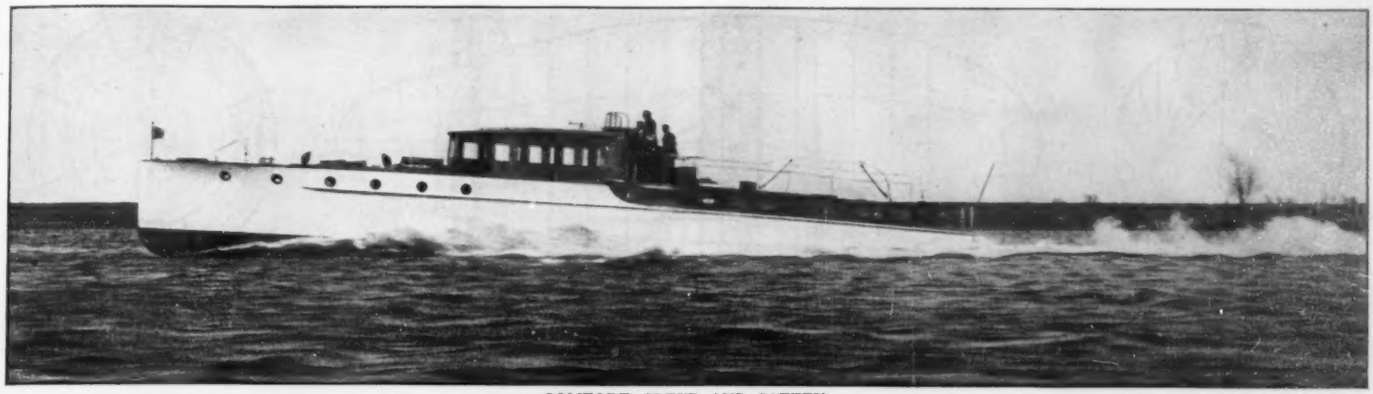
The photograph shows one of the beacons off the coast of Maine during the winter



Courtesy the "Illustrated London News"

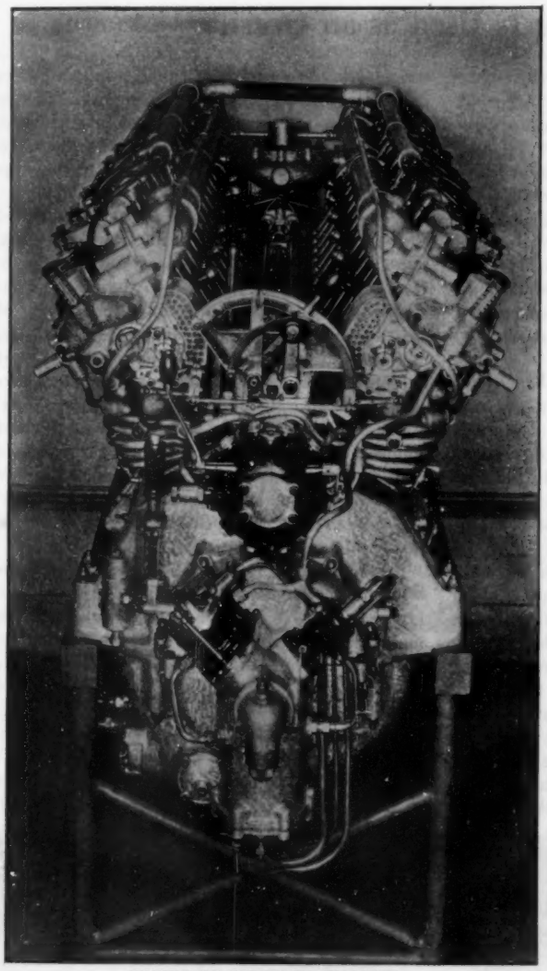
Fingerprints as Identification Marks in Ancient Greece—a Brief for Early Trade-marks

It will probably be news to our readers to know that a knowledge of fingerprints may be added to the list of Greek achievements. We present a most interesting series of pictures reproduced from "The Argive Heraeum" by Sir Charles Walston, Litt.D., Ph.D. (Houghton-Mifflin & Company). Sir Charles believes that the Greeks recognized the remarkable individualistic character of fingerprints and made some practical application of this discovery, such as the use of a fingerprint as a seal or trademark. He supports his theory with cogent arguments and the very interesting illustrations tend to demonstrate this, particularly, examples numbered 5, 6 and 7. The little seal or vase foot is the foundation of his theory, which was tested by comparisons with fingerprints in the Galton Laboratory and in the files of Scotland Yard. He considers that regular stamps and dies were produced and then pressed into the softer material. The various examples may be briefly referred to as follows: 1. Incised free-hand lines made regular by the potter's wheel. 2. Impressions on softer material by a stamp or die. 3. Painted linear ornament made regular by the potter's wheel. 4. The nearest actual type corresponding to the ancient Greek terra cotta; fingerprints from Scotland Yard. 5. At the left is the base of a small "tear bottle" with a print resembling a fingerprint; at the right, base of a seal or vase foot bearing a fingerprint pattern. 6. Enlargement of the base so as to bring out the pattern. 7. The base itself and at the left an impression from a tear bottle base. 8. Modern vases made to test whether the Greek patterns were due to the potter cutting the vase from the wheel by a string. 9. The bases of the wooden vases show no such fine lines as the Greek examples. 10, 11, 13, and 14, are given as examples of engraved stones, gems and ivories showing primitive work nearest in shape to the fingerprint terra-cotta fragment. 12. We are not deceived by the unintentional fingerprints of the potter as shown on an Egyptian wine-jar stopper. The archeologist has constantly to be on his guard against false conclusions drawn from purely circumstantial evidence.



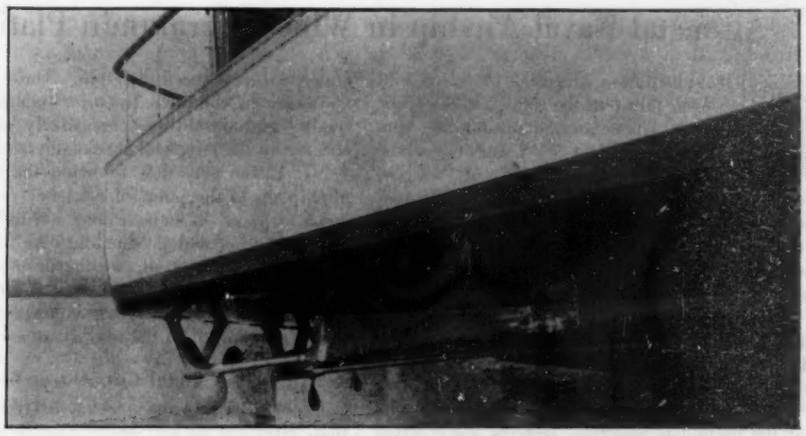
COMFORT, SPEED AND SAFETY

These were the requirements for this express cruiser which is 76 feet long with 13 feet 6 inches beam. Perfect in her appointments and phenomenal in performance, the layout segregates all the operating functions from the quarters of the master, thereby assuring privacy while the mechanical design accomplishes a speed of 34 miles per hour



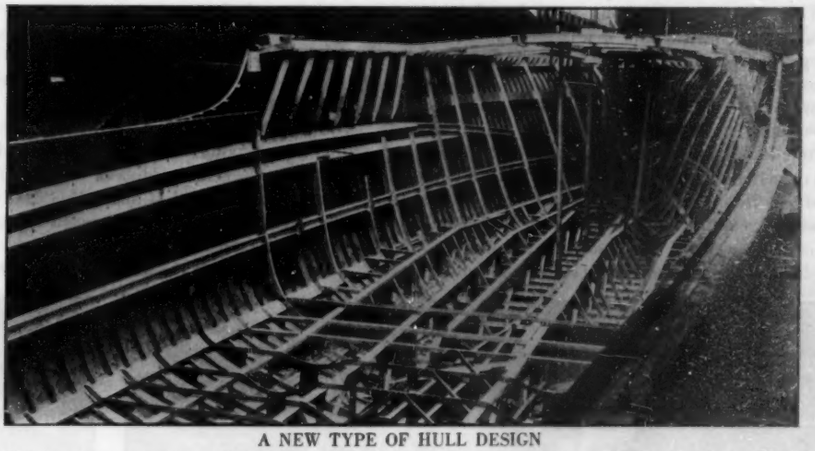
MAYBACK-ZEPPELIN ENGINES

Reversible engines like the above, of 450 horsepower, form the power plant. Coordinate control makes possible operation as a unit, complete reverse being accomplished in six seconds



AN UNIQUE FEATURE

The water-lubricated cutless rubber bearings used throughout on the propeller shafts are unusual. These are grooved spirally opposite to the turning direction of the shaft, thereby forcing water through the bearings at all times. Such flexible bearings act to eliminate vibration by holding the shafts in perfect alignment and also do away with the necessity of periodical oiling



A NEW TYPE OF HULL DESIGN

This has been created by embodying the methods used in Zeppelin airships. Double planking and oak frames reinforced with steel, are stiffened by a separate framework constructed of special corrosion-proof duralumin which is not only strong but exceedingly light

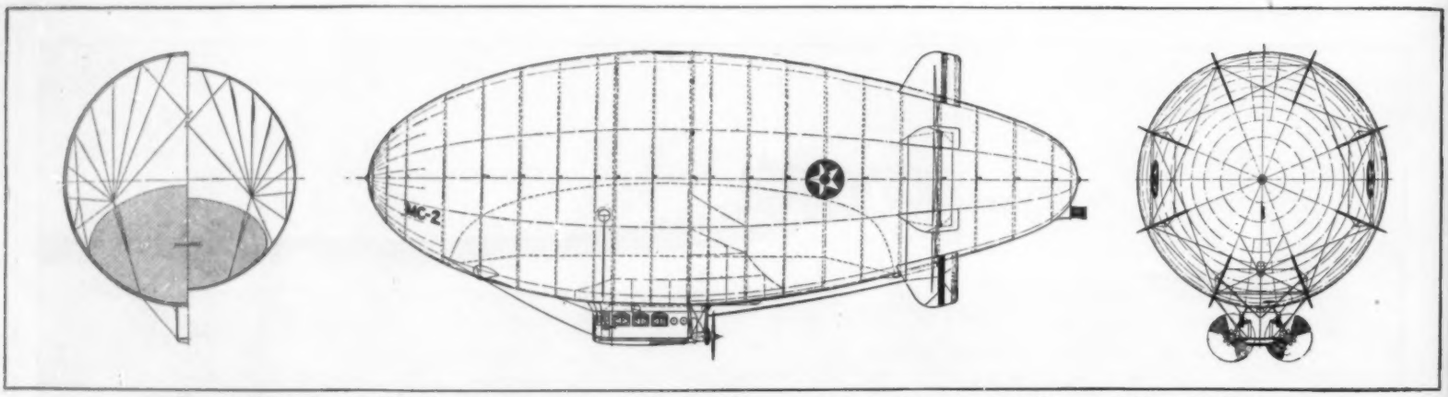
A Zeppelin Express Cruiser

Lessons learned in the air have now been applied to the water. A new type of express cruiser has been demonstrated which has a light hull reinforced by a separate duralumin framework, thereby assuring ample strength to carry powerful engines similar to those of the dirigible, *Los Angeles*.

Three 12-cylinder V-type motors with roller bearings throughout, in place of the usual babbited bearings, develop 1,350 horsepower at 1,400 revolutions per minute, consuming .42 to .48 pounds of gasoline per horsepower hour. Special carburetors render the engine fireproof.

A central control at the bridge, operates the three motors in unison. One cam shaft controls all the valves. This can be shifted so that the motor will drive ahead or astern without a clutch, complete reverse being accomplished in six seconds. Compressed air is used for starting.

A new type of quiet-running gasoline electric generating set is used, which furnishes power at 110 volts, so that all accessories may be of the usual household standard. This generator can be immediately set into action by throwing an electric switch in any place in the boat.



THE ALL-METAL AIRSHIP, *MC-2* HAS A GAS CAPACITY OF 200,000 CUBIC FEET AND A CRUISING RANGE OF 2,200 MILES AT 70 MILES PER HOUR

Metal versus Fabric

All-metal Naval Airship in Which Duralumin Plating Is Used as an Outside Covering

THE substitution of metal for wood and woven fabric in the construction of airplanes is one of the outstanding successes of the past few years of airplane design and construction. It was 16 years ago that the Scientific American offered a tentative design for an all-metal plane and pointed out the advantages of strength, reliability and high speed that would characterize a fully streamlined monoplane machine, if it were built throughout of one of the new metal alloys. To the Junkers airplane, produced some eight years later, is due the credit for the first successful demonstration of the practicability of an all-metal plane. Since that time, progress has been so rapid, that practically all of the up-to-date machines embody metal either in part or entirely in their construction. It was an all-metal plane, it will be remembered, that carried Commander Byrd on his memorable trip from Spitzbergen to the north pole and back.

The use of metal having proved such a success in airplane construction, it was inevitable that some progressive engineer would attempt its use in the construction of airships, and it is now some five years since a group of leading automobile manufacturers of Detroit authorized their chief engineer, Ralph H. Upson, to proceed with his designs for an all-metal ship. The confidence which led the Aircraft Development Corporation to enter upon the heavy expense of this investigation was based upon a consideration of five notable advantages which such a ship would possess over the present skeleton-frame, fabric-covered dirigible. These are strength, resistance to complete fracture, lightness, fireproof quality and durability, particularly as regards resistance to the effects of the weather.

Mr. Upson saw that to bring the present rigid airship up to the point of efficiency realized by the metal airplane, in its own field, would be a problem of engineering and production. An airship of this type must be fireproof, weatherproof, durable and firm in its structure, able to meet and carry through in any kind of weather that it may encounter, and lastly, economical in the use of gas and ballast.

Use of Metal Cuts Down Weight

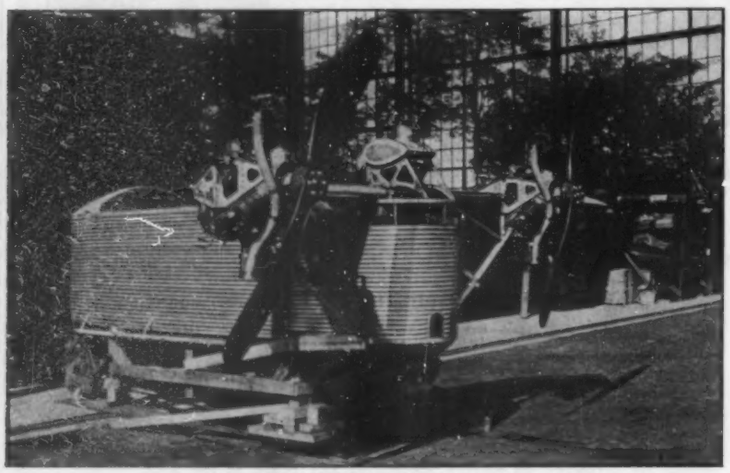
Experience with the present dirigibles has shown that, after not so very many months of continuous service and exposure to the atmosphere and weather, the fabric covering deteriorates so rapidly that the ship is no longer safe to navigate, and when that point is reached, the old covering must be removed and an entirely new one put on.

The first design, which was for an express airship of 1,600,000 cubic feet, revealed a load-carrying capacity, speed and power efficiency superior to that of the larger fabric-covered ship, *Shenandoah*. Moreover, in summing up the statement of weights, the encouraging disclosure was made that there would be an actual reduction in weight as compared with fabric-covered ships. This is due largely to the fact that the outside metal plating not only carries the tensile and shear stresses, but also, by so doing, reduces the size and weight of the internal framework. For we must bear in mind that, because it yields so rapidly to pulling or stretching loads, the outer fabric cannot take care of the shearing stresses; its only function is to resist the air pressures developed in flight and to give to the ship the necessary, unbroken streamline form.

In the *Shenandoah* the shearing stresses were carried by an elaborate system of diagonal wires between the various intersecting points of the metal framework. Were it not for these, the bending stresses on the hull would cause the framework to twist out of shape. Just here it is interesting to note that Rear-Admiral Dyson, one of our ablest engineers, noted on his inspection of the wrecked ship that several of these diagonal wires in the framework, either broke or pulled out from their connections at the intersections of the main girders.

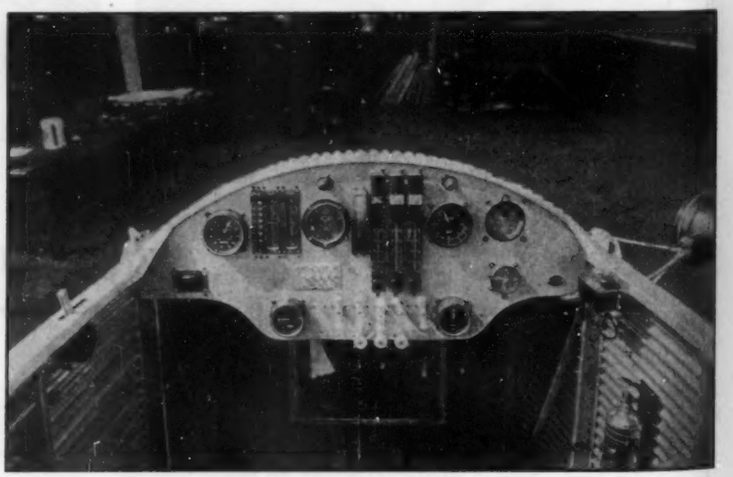
Both the mathematical and experimental investigation of the metal ship showed that the metal cover can take care of these stresses with a considerable factor of safety.

Compared with the fabric-covered ship, the metal-clad has but one surface layer as against five layers (exclusive of frame) from outside to inside, namely: first, the outer covering fabric; second, the shear wiring; third, a network of wiring to take the gas pressure; fourth, the cord nettings; and fifth, the gas cell fabric lined with goldbeater-skin. To these must be added the main framing of the ship. As compared with the above, the metal-clad ship consists of an exterior gas-tight, metal-covered shell, to the inside of which is riveted a system of longi-



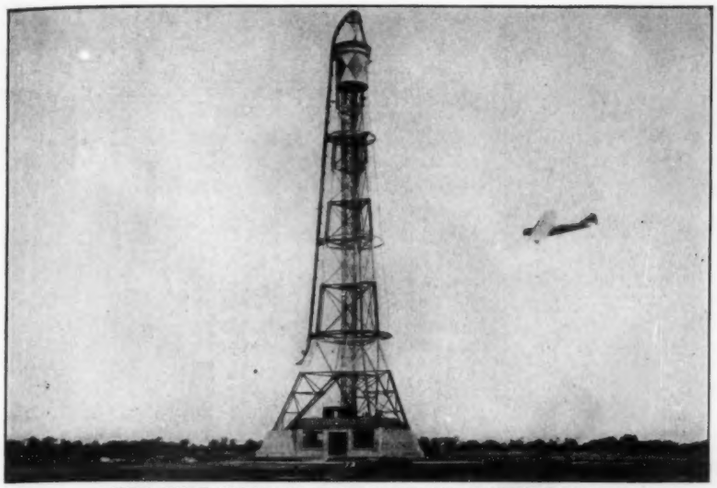
ENGINES FOR THE *MC-2*

These three-cylinder engines show the type of the nine-cylinder ones to be used



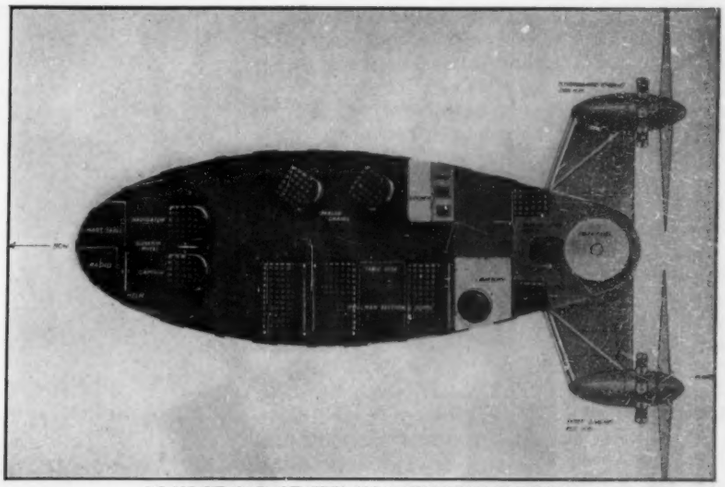
THE ALL-METAL CAR

The framing and the corrugated sides and floor are of special duralumin metal



NEW TYPE MOORING MAST AT FORD FLYING FIELD

The ship moors at the top of track at left and is hauled down the track to the ground



PLAN OF CAR OF THE *MC-2*, SHOWING ENGINES

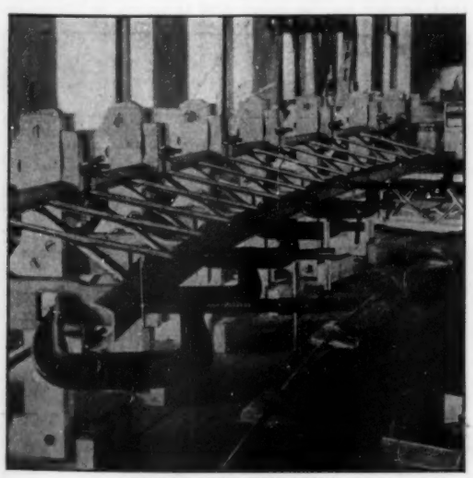
Notice the pullman accommodations, galley, lavatory, fuel tanks and control equipment

tudinal and transverse girders which, because the shear stresses are taken in considerable part by the metal cover, is relatively much lighter than the corresponding independent framing of the fabric-covered ship.

For several years past, the Aircraft Development Corporation has carried on a series of investigations, in the navy wind-tunnel, in the laboratories of the General Motors Company and at the Bureau of Standards, Washington, D. C.

It was decided to build, at first, a small experimental ship of 200,000 cubic feet capacity, which is about the size of the largest known non-rigid blimp that has so far been constructed in this country. At recent hearings before the Committee on Naval Affairs of the House of Representatives, the leading officials of the company including Ralph H. Upson, Chief Engineer and Carl B. Fritsche, General Manager, appeared before the commission and presented the mass of data which had been gathered. As a result, it was decided that the new ship should be built for the navy to be used in experimental service and for general training purposes, and an appropriation of 300,000 dollars was recommended.

As regards the matter of construction, instead of building the girders of triangular cross-section, with three longitudinals latticed together, comparatively simple girders of modest proportions will be used for short spans, intercostals, and stiffeners. These are formed out of a single sheet and finished in a punch press. Various sample control members such as fins and rudders have been built and loaded with sand to the point of destruction. In every case they have exceeded the designed factors of safety. In fact, samples of most of the other members and details have been made with the result that the actual building of the ship will be mainly a job of reproduction.



READY FOR RIVETING

A main longitudinal member lined up in the jigs. There are no straight members, all being curved

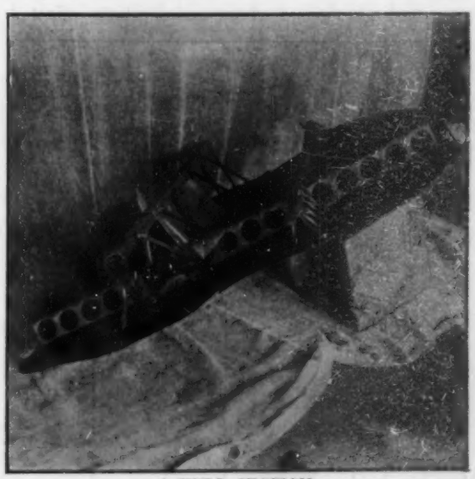
Since the 200,000 cubic-foot capacity ship which is to be built for the Navy contains no separate gas cells, but consists essentially of one gas cell formed by the metal covering, it will be realized that the matter of gas-tightness is all important. The seams of the metal, both longitudinal and lateral, are lap-riveted with three rows of rivets to the seam. To do this work, a most ingenious little riveting machine has been developed by Edward Hill, formerly of the naval aircraft factory at Philadelphia, which is capable of putting in 7,500 rivets per hour. Three small wire rods pass through the upper arm of the riveter and punch their way through the plates. They are then sheared off and the rivet heads closed —all of these operations being automatic and continuous. The all-important question of gas tightness has been solved by these triple-riveted seams. It was already known that riveted steel gasometers are much tighter than any holders made of fabric, and hence the same relative rivet spacing was adopted as is used in gasometers. The rust that works into the seams of a steel gasometer assists greatly in making them tight, and this quality is supplied in the airship by using a specially-prepared seam dope. Here again surprising results were obtained. Careful tests have shown that this rivet-and-dope construction averages, in the specimens tested, less than one-tenth the leakage usually specified for goldbeater-skin fabric.

Zeppelin Shape Not Efficient

Another advantage of the use of metal-covering is that it eliminates the flapping and the moisture absorption which are common to fabric. Critics of the use of metal covering have claimed that it would fail due to flapping and vibration effects. Laboratory tests, however, have shown that, after combined flapping and torsional stresses, carried to the extent of many millions of movements, there has been no depreciation in the strength of the metal. Distortion of the ship from its original circular form is prevented largely by the double curvature (longitudinal and transverse) of the hull surface.

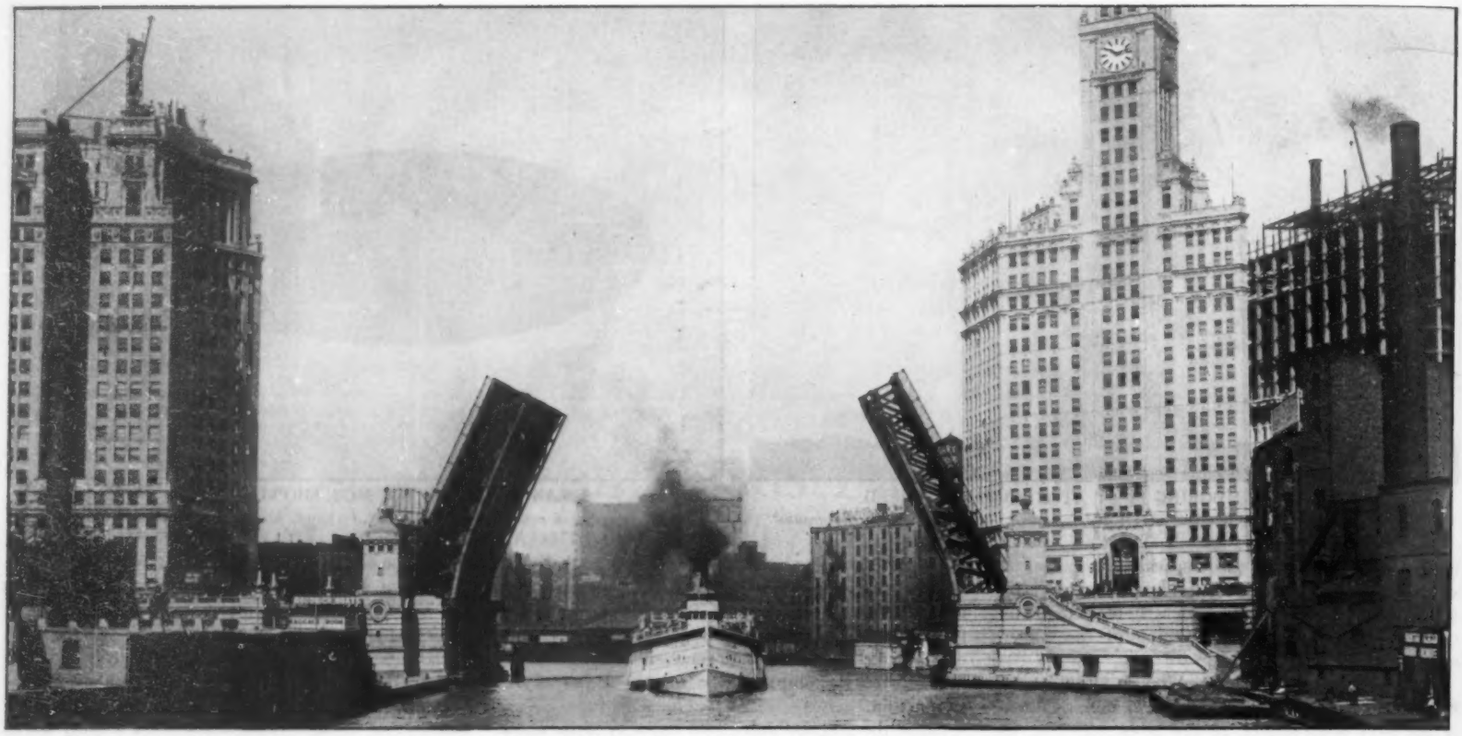
We have already remarked that the experimental investigation of the proposed ship brought several agreeable surprises. Among these is the fact that a ship with a fairly short and compact hull, is much more easily driven than a ship of the typical Zeppelin type. Zeppelin believed that for ease of propulsion, a long ship of relatively small diameter was necessary and subsequent construction has been guided apparently by that same belief; but the navy wind-tunnel experiments show that the new plan hull form has a lower resistance for equal volume than any shape hitherto produced. The length-diameter or fineness ratio of the *MC-2* is only 2.8 to 1, that is to say, the metal-clad ship is only 2.8 times its diameter in length whereas the *Shenandoah* was 8.6 to 1 and the *Los Angeles* is 7.2 to 1.

Early this year, in an address before the Society of Automotive Engineers, Chief Engineer Upson made an interesting comparison of the new ship with the *Shenandoah* as regards their relative longitudinal strength. He states that the worst bending-moment for ordinary operation considered in the design data of the *Shenandoah* was reached at an angle of pitch of six degrees relative to the air and at a speed of 46 miles per hour. Assuming hydrogen inflation at the blow-off pressure of 10 millimeters, a safety factor of 1.68 is indicated in the top longitudinal members. The *MC-2* (metal-clad) under the same conditions, except with blow-off pressure of 100 millimeters, shows a minimum longitudinal factor of safety of 9.61. The fabric covering of the *Shenandoah* offered practically no resistance to bending stresses. The instant such stresses were applied, the fabric stretched, throwing the whole load upon the framework. In the metal-clad, the outer metal covering assists very materially in carrying such stresses.



A HULL SECTION

This shows sections of the longitudinal and transverse members attached to the outer duralumin covering



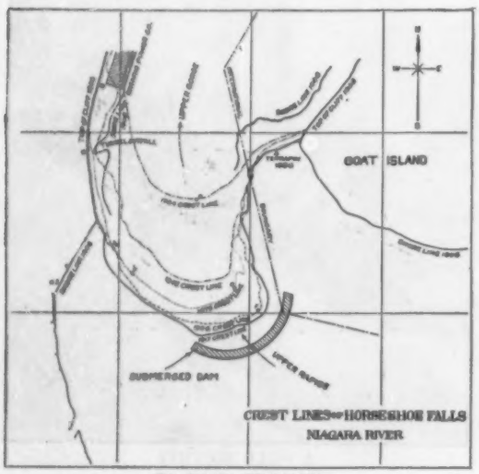
LOOKING UP THE CHICAGO RIVER FROM LAKE MICHIGAN

What Lowered the Great Lakes

Jupiter Pluvius, Not Chicago, Mainly Responsible for Low Lake Levels

By J. Bernard Walker

FOR the past nine years, the level of the Great Lakes has been sinking steadily. Look at the diagram at the bottom of the following page showing lake levels from 1860 to 1925. Today, they are 25 inches below normal. These low levels are causing serious concern—as well they may. The Great Lakes' shipping, which has carried 110,000,000 tons of freight during the open season, is alarmed because the various channels which were blasted or dredged by the army engineers to provide 22 feet of water, now show only 20 feet; and since ships cannot load to their full draft, there is a resulting loss to the carriers of about three million dollars per year. Various harbors are similarly affected, and if the lowering of the levels continues, costly dredging will have to be resorted to. Suburban residents, alike in the costly mansion and the modest bungalow, find that the water which formerly bordered their lawns and grass-plots, has receded until wide stretches of mud or shingle spoil the appearance of their homes.



TO STOP EROSION

An army plan calls for the submerged dam shown

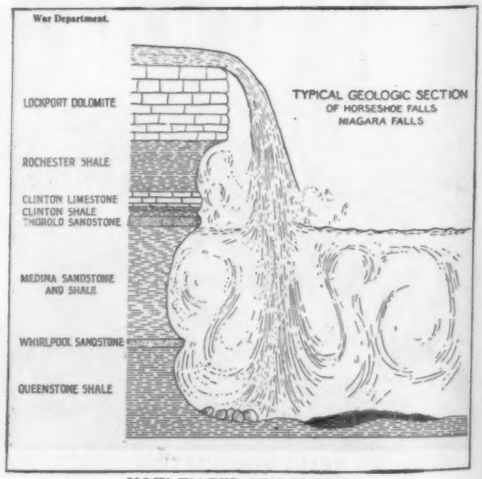
Chicago Not the Culprit

Let us now turn our thoughts to the largest of the lake cities, Chicago. In the early years of its growth, Chicago allowed its sewage to flow into the small Chicago River, a few miles in length, which empties into Lake Michigan. From Lake Michigan, Chicago takes its drinking water. As Chicago grew in population, the inevitable happened and the city was visited by serious typhoid and other epidemics. The bacteria got into the drinking water. To remedy this condition, Chicago dug a large drainage canal 24.4 feet deep, from 161 to 300 feet in width, and 28 miles in length, from the Chicago River to the Des Plaines River which empties into the Illinois River. This, in turn, empties into the Missouri River. The canal was cut with a down grade from the Chicago River to the Des Plaines River and the Chicago River was dredged and widened. Hence, when the canal was completed, the flow of the Chicago River was reversed and the water flowed from Lake Michigan, by way of the canal, into the watershed of the Mississippi River. Today, the water from Lake Michigan flows at the rate of about 8,000 cubic feet per second from the Lake to the Mississippi Basin, carrying with it the sewage of a city of 3,200,000 people.

The withdrawal of this amount of water has lowered the levels of Lakes Michigan and Huron by five inches.

The drainage canal was opened in 1900, and in the eight years that followed, there was plentiful rainfall and the drop of five inches was not noticeable. Nobody thought or cared anything about the matter. But, in the year 1909, the level of the lakes began to fall and people began to ask why. In 1917, there set in a period of diminished rainfall which has continued to the present day, with the result that the lakes are at a lower stage than at any time since 1860. Our diagram, showing the fluctuations of the levels in Lakes Michigan and Huron, tells the story.

Now, when it became manifest that there was taking place a steady fall of levels, the great cities that border on the lakes and the vast shipping in-



HOW WATER UNDERCUTS

The erosion causes the overhanging rock to fall

terests began to look for a culprit, and they thought they had found it in the Chicago drainage canal. Thanks to a widespread (nation-wide in fact) propaganda, the public has been led to believe that the whole trouble should be charged to Chicago.

This is unjust; for, as government statistics show, Chicago is responsible for only one-fifth of the shortage—20 inches being due to small precipitation and rather high evaporation, and only one-fifth, or five inches, to the water drawn off through the Chicago Drainage Canal. Let us turn to the records of the Weather Bureau. We quote from a recent report by P. C. Day, head of the Bureau: "The longest period with precipitation continuously below normal over practically all portions of the basins, embraces the last eight years of the period 1917 to 1924. . . . Including 1925, the period is increased to nine years. The average deficiency for the entire watershed during this period was more than two inches per year and ranged up to six inches or more in some portions."

Engineers Can Circumvent Climate

To understand how from two to six inches deficit could have pulled the levels down to the present stage, study our map entitled "Great Lakes Drainage Basin," from which it will be seen that the deficit was felt not only over the lakes themselves, but over the land area draining into the Lakes.

From all of this it will be evident that the lowering of the lakes is not due so much to the struggle of Chicago to solve its portentous sewage disposal problem as it is to climatic conditions.

Chicago is not the only center at which water is being artificially drained out of the Great Lakes. We have before us a letter from the Secretary of War, transmitting letters from Brigadier-General H. Taylor, Chief of the Corps of Engineers, and reports by Col. J. G. Warren and by the Board of Engineers for Rivers and Harbors, dated 1921, from which we learn that the Chicago Drainage Canal was then withdrawing 8,800 cubic feet per second, the Welland Canal 4,500 cubic feet per second, the Black Rock Ship Canal, 700 cubic feet per second, the New York State Barge Canal 1,000 cubic feet per second, and the Niagara Power Companies, 50,885 cubic feet per second—all of these withdrawals having their effect upon the level of one or all of the Great Lakes, except Lake Superior. The outflow from Lake Superior is controlled by sluice gates, and the level of that lake can be maintained.

WATERSHED OF THE GREAT LAKES

It is not extensive and drainage to the lakes is small. The supply is not great enough for the demand

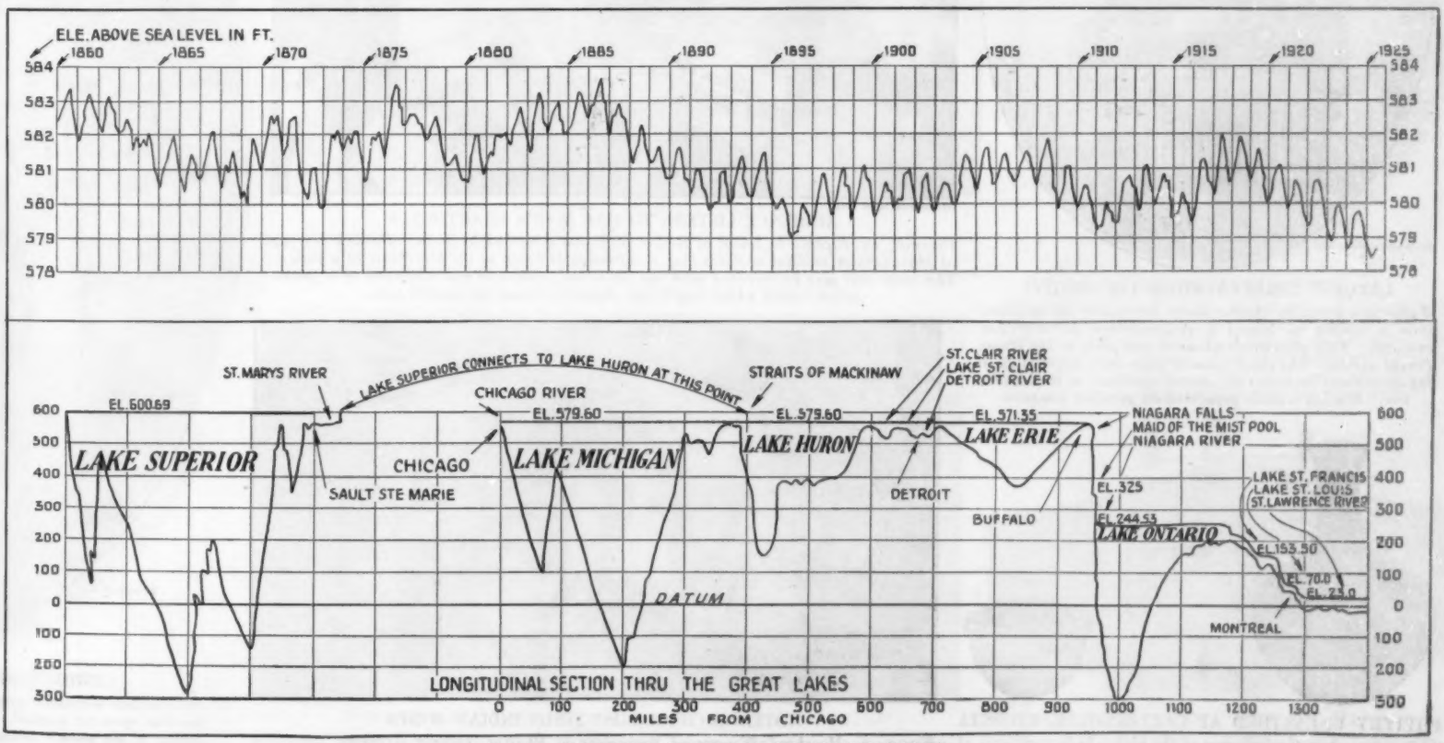
If the raising of the lakes by over two feet was mainly dependent upon the rainfall, the outlook would be extremely alarming; although the Weather Bureau report on lake levels has this to say. "It is therefore safe to predict that fluctuations in the amount of precipitation over this region will occur in the future as in the past, and we shall again experience the generous distribution received during the earlier years of rainfall measurement in this region." But, fortunately, we do not have to rely exclusively upon the caprices of the climate; for it is within the resources of skilled engineering to raise the lake levels to any desired stage and maintain them at that stage independently of the rainfall fluctuations. Fortunately, the matter of artificial withdrawal of water from the lakes is under strict federal supervision. The permissions to draw water which have been made, were granted as a temporary or emergency measure only, particularly in the case of Chicago, whose permit is revocable at any time. The corps of army engineers, which has immediate supervision of this matter, is jealously guarding the interests of all concerned in this matter, and in the report above referred to they urge that no further permits for the withdrawal of water shall be made.

But, by far the most important and effective method of raising lake levels is by the construction of submerged weirs at the entrance to the St. Claire River at the southerly end of Lake Huron and at the entrance to the Niagara River. These weirs would not present a particularly difficult engineering job and the cost, in comparison with the benefits received, would be comparatively light. The natural outflow from the lakes would continue as before.

Niagara Falls in Danger

We present two diagrams showing conditions at Niagara Falls and one of the plans by which the army engineers would permanently restore their beauty. Because of the great amount of water which flows over the center of the Horseshoe Falls, there is a serious and rapid undercutting of the cliff, and at low water, long stretches of the crest line near the Canadian side and near Goat Island are laid bare. The army engineers suggest the building of a curved submerged dam a certain distance back of the Horseshoe Falls, for the purpose of diverting a large portion of the flow toward the shoaler portion of the falls and reducing the amount of flow at the center, where the undercutting is taking place. With such a work installed, they claim that not only would the scenic beauty be permanently preserved, but it would be possible to double the amount of water that is used for hydraulic electric power.

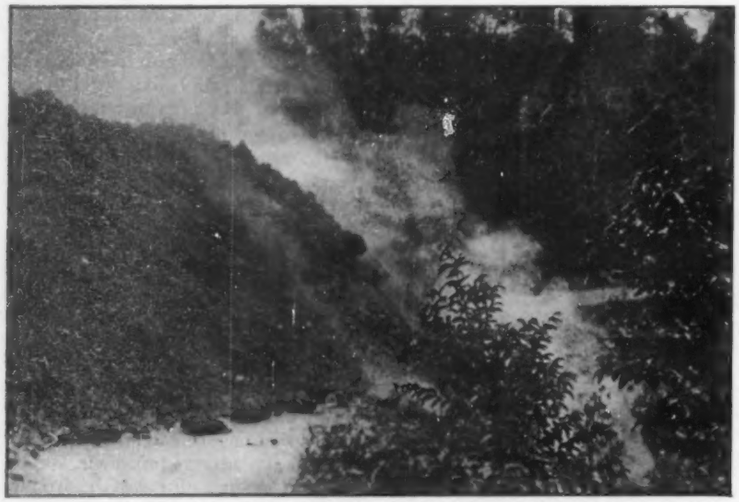
¶ In our October issue, we shall deal with the Sanitary District of Chicago and describe the great sewage treatment works which will ultimately reduce the amount of water that will be drawn off from Lake Michigan.



FACTS ABOUT THE LEVELS OF THE GREAT LAKES

Upper diagram shows the variation of the levels of Lakes Huron and Michigan. Lower diagram is a longitudinal section showing the depths and recent mean surface levels

From the Scrap-book of Science—Ca



MAUNA LOA LAVA INVADES HAWAIIAN COUNTRYSIDE

The recent eruption of fluid lava from Mauna Loa resulted in the burial of a seaside village. Creeping seaward down the gentle mountain slope, this molten river of minerals was irresistible. Houses, walls and other man-made obstructions easily fell before the slow advance of the pasty mass of moving rock. In the illustration it appears to be partly cooled, yet only a few inches beneath the grey face of the advancing wave, its color was dull red. The volcanoes of Hawaii are not of the explosive or violently eruptive type

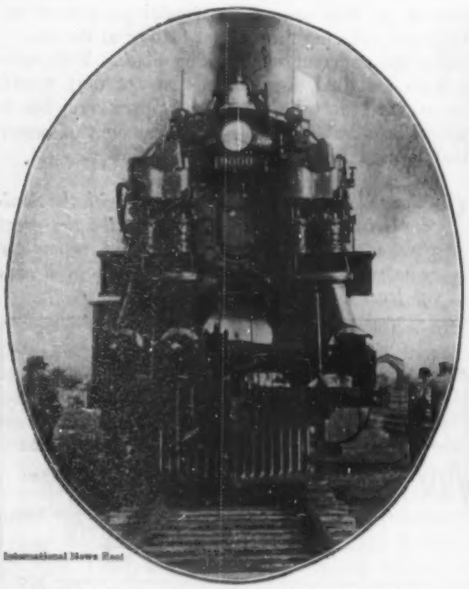
© London Times from Acme

ANOTHER TELEVISION SCHEME

An English inventor, J. L. Baird has devised a system for television over telephone wires. The photograph above is a reproduction of the face of the inventor as it was received during a recent test. The apparatus for transmitting the image is called the "Televisor"

TESTING ATHLETES BY S

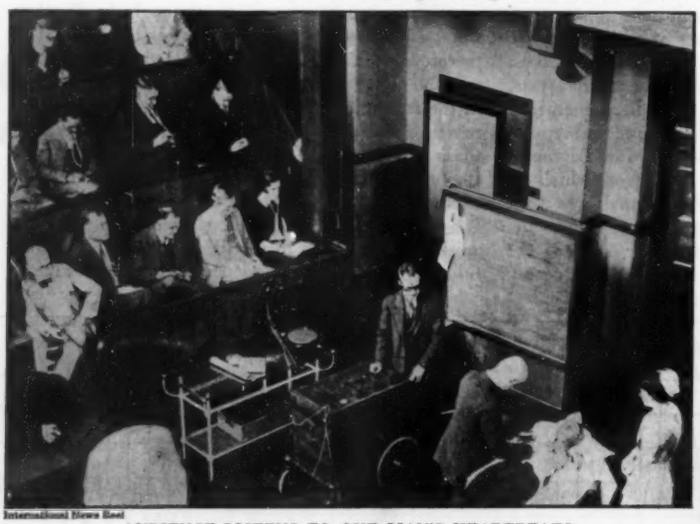
Clarence De Mar, long distance runner, s scientists, to determine the effect of st respiratory organs. De Mar ran 15 mil him which may result in some discoveries of the athletic world, as w



International News Reel

LARGEST THREE-CYLINDER LOCOMOTIVE

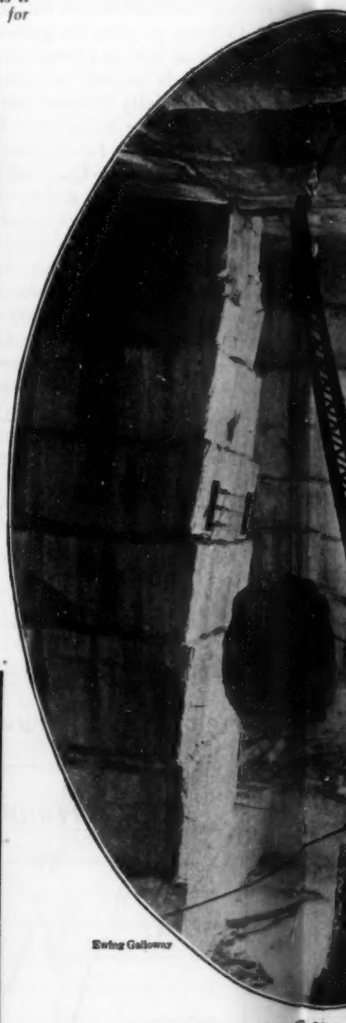
Within two years, the three-cylinder locomotive has advanced from a novelty to almost a commonplace on American railroads. This photograph shows a new giant of the Union Pacific system. The third cylinder gives more uniform starting torque and increases the overall efficiency of the locomotive. Bearing trouble prevented its previous adoption



International News Reel

AUDIENCE LISTENS TO ONE MAN'S HEARTBEATS

Recently, Dr. Richard C. Cabot of Boston perfected a method by means of which a group of physicians or medical students may simultaneously listen to the heartbeats of a patient. The beats may also be recorded with the physician's comment and diagnosis on a phonograph record which may be amplified by means of vacuum tubes



Ewing Galloway

UNIQUE METHOD OF QUA

At Proctor, Vermont, quarrying is done b familiar open-cut method. The roof of the ceiling of the quarry, obviating the necessity Huge blocks of stone are removed in this w expensive stripping away of u

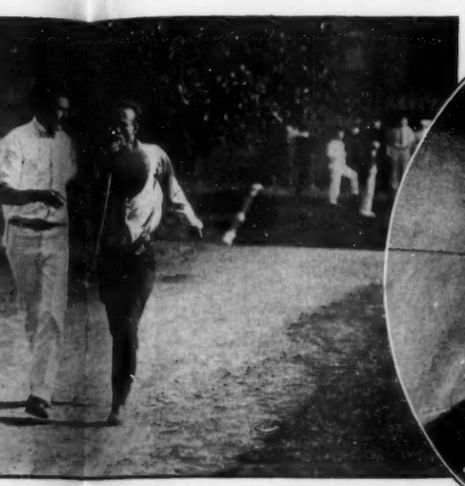
POTTERY UNEARTHED AT CARTERSVILLE, GEORGIA

These vases show the influence of the higher Indian cultures of Middle America, which spread in modified form over much of North America from this southern source

NOTED ARCHEOLOGIST FINDS INDIAN BONES

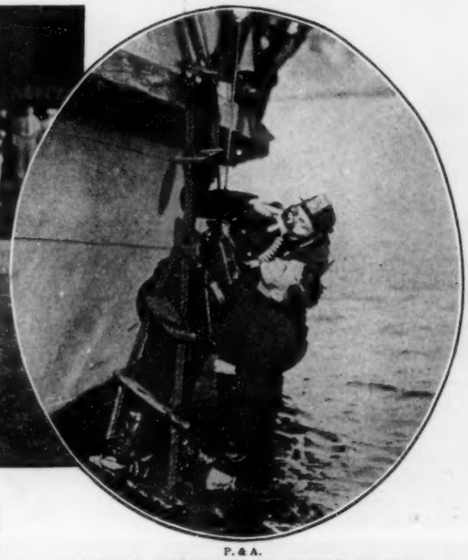
Warren K. Moorhead, Director of Archeology at Phillips Andover Academy, trowelling out earth where cremated Indian body was found in an urn in Georgia. Dr. Moorhead is the author of a noted work on Indian artifacts and cultures

—Camera Shots of Scientific Happenings



ATHLETES BY SCIENTIFIC METHODS

g distance runner, subjected himself to tests by Boston ne the effect of strenuous exercise on the heart and De Mar ran 15 miles while physicians made tests on t in some discoveries of great value to many branches athletic world, as well as to physiology



P. & A.

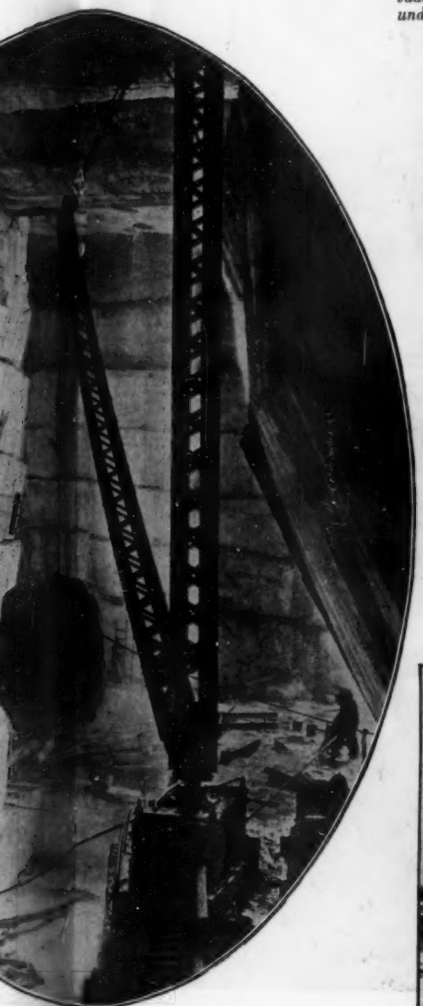
WEARING SMOKE MASK UNDER WATER

Smoke masks equipped with oxygen tanks, such as are now used by firemen in most of the large cities for invading buildings filled with smoke, may be used for underwater work of short duration. The photograph shows a rescue with such a mask

P. & A.

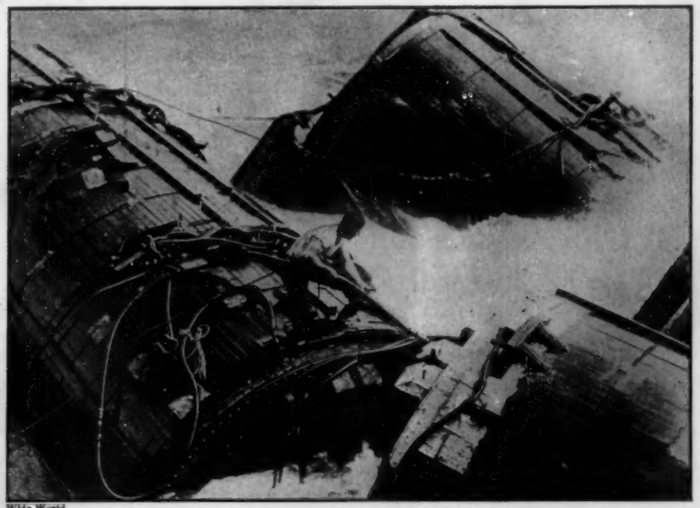
GOVERNMENT BULB EMBARGO FOSTERS AMERICAN BULB CULTURE

When U. S. Department of Agriculture scientists found plant diseases on Dutch lily bulbs, and stopped their importation, a new American industry was made possible. For centuries, the Dutch have been famed for their bulbs which have figured in literature and song, being noted the world over. But bulbs that are now being grown in central Florida already rival the perfection of those grown in the Netherlands. When the embargo on Dutch bulbs is raised, can the American grower compete with the thrifty, hard-working Hollander?



METHOD OF QUARRYING MARBLE

quarrying is done below ground instead of by the d. The mast of the derrick is let into a hole in the voiating the necessity of providing the usual guy lines. re removed in this way without the necessity of the e stripping away of useless overburden



Wide World

RAISING THE SUBMARINE *S-51*, A "MAN'S JOB"

Unexpectedly, the bow of the sunken submarine rose to the surface in a rough sea, the stern remaining on the bottom. Quick work was necessary to open the flood valves and sink the buoyant pontoons which were crashing together ominously. A navy man boarded the gyrating pontoons and kept the air lines from fouling

Wide World

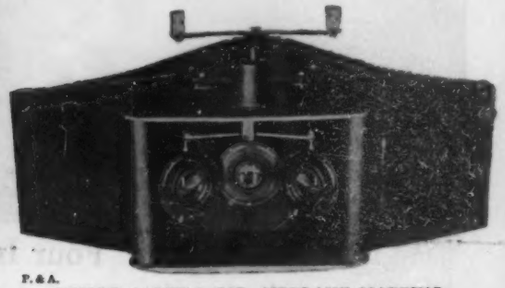
ARE YOU LEFT-EYED?

The respective sides of our bodies connect with opposite sides of the brain. Professor P. E. Livebach of Emory University believes that nine times out of ten, left-handed people are also left-eyed. There is a wide difference between the left and right eyes of many persons, as they do not always converge on objects in the same way

International News Reel

FUSED QUARTZ, IDEAL NEW MATERIAL FOR THE SCIENTIST

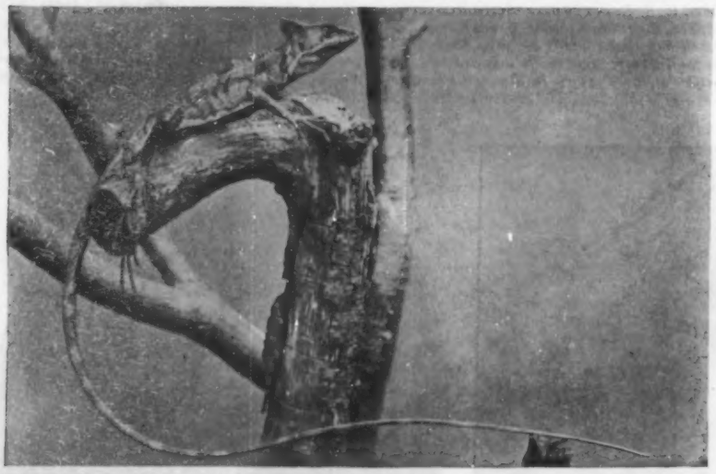
Peter Hidnert, Associate Physicist, U. S. Bureau of Standards who just prepared a government scientific paper on fused quartz, a material which may safely be plunged, red hot, into ice water. Since it contracts little when cooled, it does not break

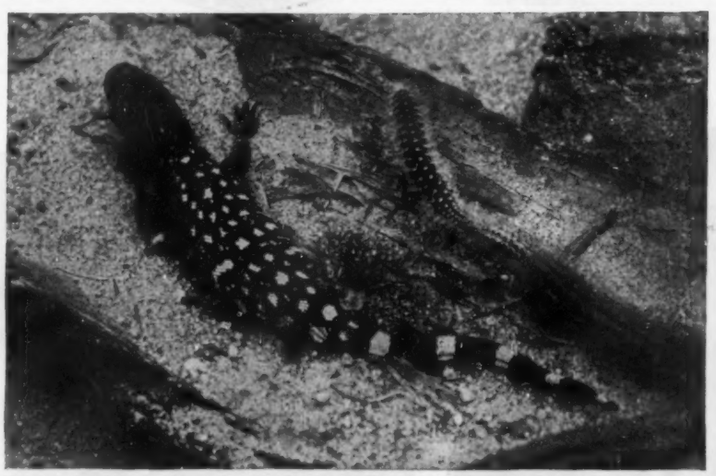


P. & A.

TRIPLE CAMERA FOR AIRPLANE MAPPING

Together these lenses photograph a broad strip of territory near the airplane. The film advances and is exposed automatically as the airplane flies over miles and miles of territory

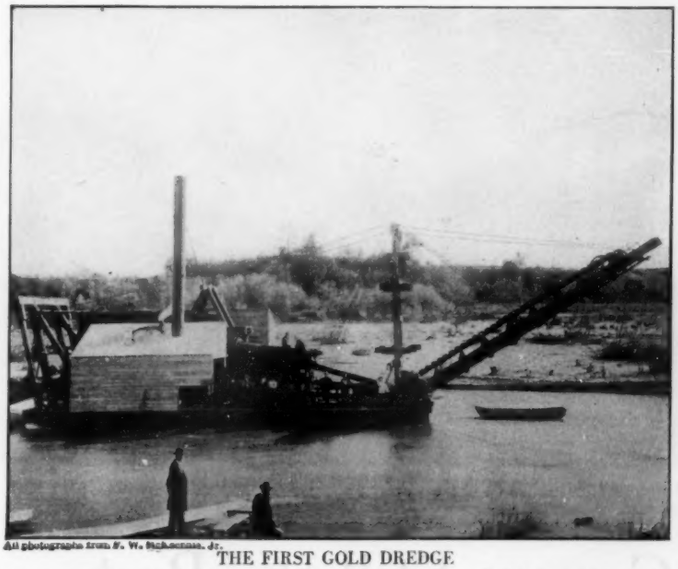




Photographs through the courtesy of American Museum of Natural History

Four Interesting Members of the Reptile Family

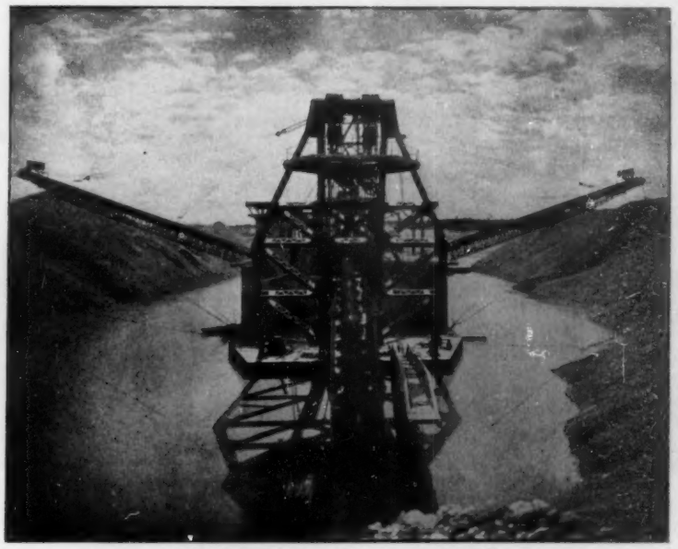
Two of the groups in the American Museum of Natural History, are shown at the top and bottom of this page. In the center, at the left, is a picture of a crested basilisk and opposite is a photograph of a beaded lizard. All of the lizards shown were photographed from life by Professor Raymond L. Ditmars. The upper group is known as the rhinoceros iguana group. The group was planned by Dr. G. K. Noble of the American Museum of Natural History. The lower picture gives us a glimpse into the home life of the iguanid lizards of Lower California, and shows the great diversity of forms found.



All photographs from F. W. Stahlecker, Jr.

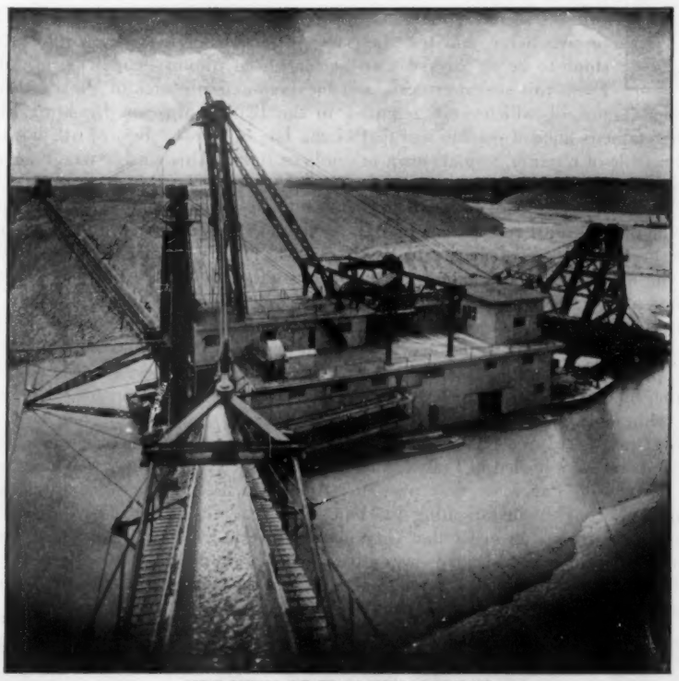
THE FIRST GOLD DREDGE

The first gold dredge built to do, on a large scale, what the individual prospector did with the pan. Compare this with the huge machines shown in adjoining illustrations which dig 15,000 yards per day



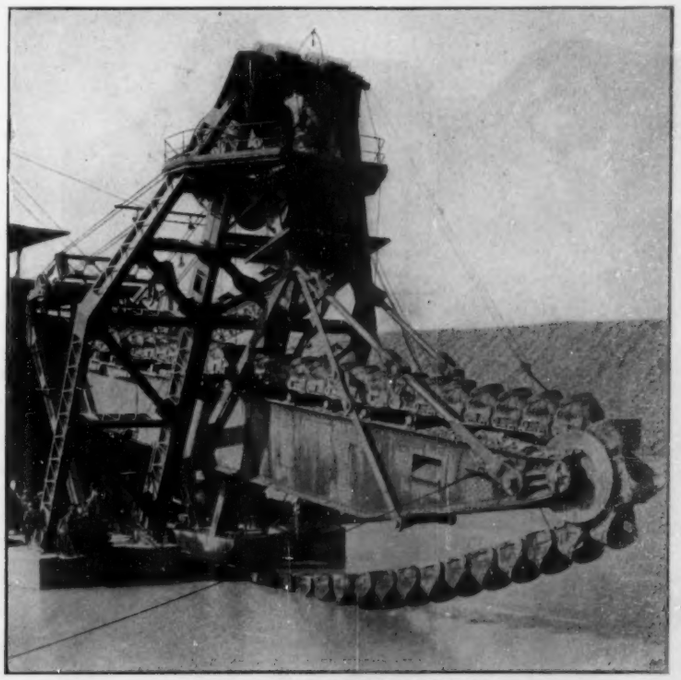
MASSIVE GOLD DREDGE OF TODAY

This huge machine, weighing 2,600 tons, cuts its own channel through the gold-bearing river sands, sifting out the fine flakes of gold and depositing the waste sand in piles on either side of the channel



SIDE VIEW OF FLOATING DREDGE

The endless chain of buckets at the right is scooping up material from the river bed, which is delivered to screens within the hull where the fine gold-bearing sand is retained and the gold extracted



FRONT END OF LADDER DREDGE

This ladder can be lowered to work at a depth of 81 feet. Each bucket weighs two tons and can scoop up 14 cubic feet. Each boat can handle 15,000 cubic yards of the gold-bearing gravel per day

Huge Gold Dredges of the West

The world's biggest digging job is under way on the Yuba River—the historic producer of millions of dollars in the days of the California gold rush. In this region, six gold dredges, successors to the "forty-niners" and their "long Toms" have dug 340,000,000 cubic yards of material, and a survey of the gold-bearing sands shows that they have ten years of digging ahead of them. Already, six of these great dredges, each costing from 700,000 to 1,000,000 dollars, have recovered 50,000,000 dollars in gold. The pioneer miner, working in the California stream beds, was able to dig and put through his sluice box only a few cubic yards of the gold-bearing gravel in one day; but each of the modern gold dredges, working 24 hours a day, handles 15,000 cubic yards, that is to say, it does the work of many thousands of the pioneers of '49. Briefly, the gold dredge may be described as a bucket elevator mounted on a pontoon or barge, with an opening or well at one end through which an endless chain of buckets is operated. The buckets pass over a large circular tumbler at the lower end of the digging ladder and the entire bucket line is operated by a power-driven sprocket or tumbler at the upper end of the ladder. The ladder is hinged at its upper end and its lower end may be raised or lowered as desired. The buckets carry the gravel up to a hopper from which it passes into a revolving screen which separates the gravel from the gold-bearing sand. The coarse material is then conveyed to the rear of the boat. The fine gravel and the sand pass over riffles or tables, where mercury amalgamates with and saves the fine gold. The dredges are of massive construction. The ladder weighs 250 tons and the lower tumbler 20 tons.

THE VILLAGE WHICH HAS FURNISHED MARBLE FOR NEARLY ALL THE SCULPTURES OF THE MODERN WORLD

The white drifts that look like snow on the sides of the hills are really the unused fragments of brilliant white marble thrown out on the dumps of the many quarries

Snow-white Marble of Carrara Still the Best

HOW THE MASS OF MARBLE LOOKS IN PLACE

Quarrymen carefully study the surface of each exposed layer, to determine just how large, solid blocks can best be cut from it

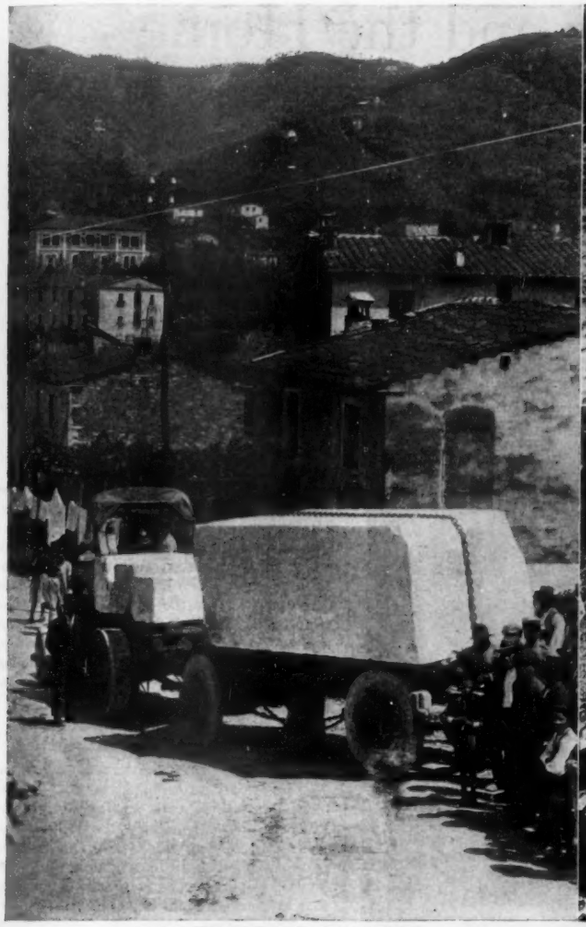
THE great sculptors of antiquity worked under a double handicap. The rules of their art were still to be formulated and, worse still, they had to search out and test their own materials. The first really suitable stone to be discovered was the marble of Mount Pentelicus, in Attica. From this marble were made the famous sculptures of the Parthenon, in Athens, most of which were removed to the British Museum by Lord Elgin. Another famous ancient marble was that of the Isle of Paros. Best of all, however, is the marble of Carrara, a small town in southern Italy. This marble was discovered in Roman times but was then called Lunan marble, from the Roman town of Luna, close by. After the fall of Rome, the Carrara quarries were abandoned for centuries, until the architectural renaissance of Italy in the Twelfth Century. Since then, most of the great sculpture of the world has been done in this Carrara stone.

In the mountains near Carrara all the factors of earth history have combined to produce a stone of extremely uniform texture and color and broken by very few fractures. The largest blocks of perfect marble ever quarried have been obtained from these beds. Among the six hundred or more separate quarries which have been opened in these mountains, only a few produce the very best grades of marble. In other places the original chalk was not pure enough and the marble lacks the clear white color which makes it so much admired.

Since the World War, the graves of the many thousands of American soldiers who died and were buried in France, have been marked by temporary wooden crosses, "row on row." For some time past, the American Battle Monument Commission has been thoroughly investigating the numerous available materials with which to replace these crosses in order that they may endure indefinitely. American granite —hard, durable, but expensive—was given consideration, but Carrara marble was finally chosen because of its beauty, greater accessibility and because it could be worked comparatively easily.

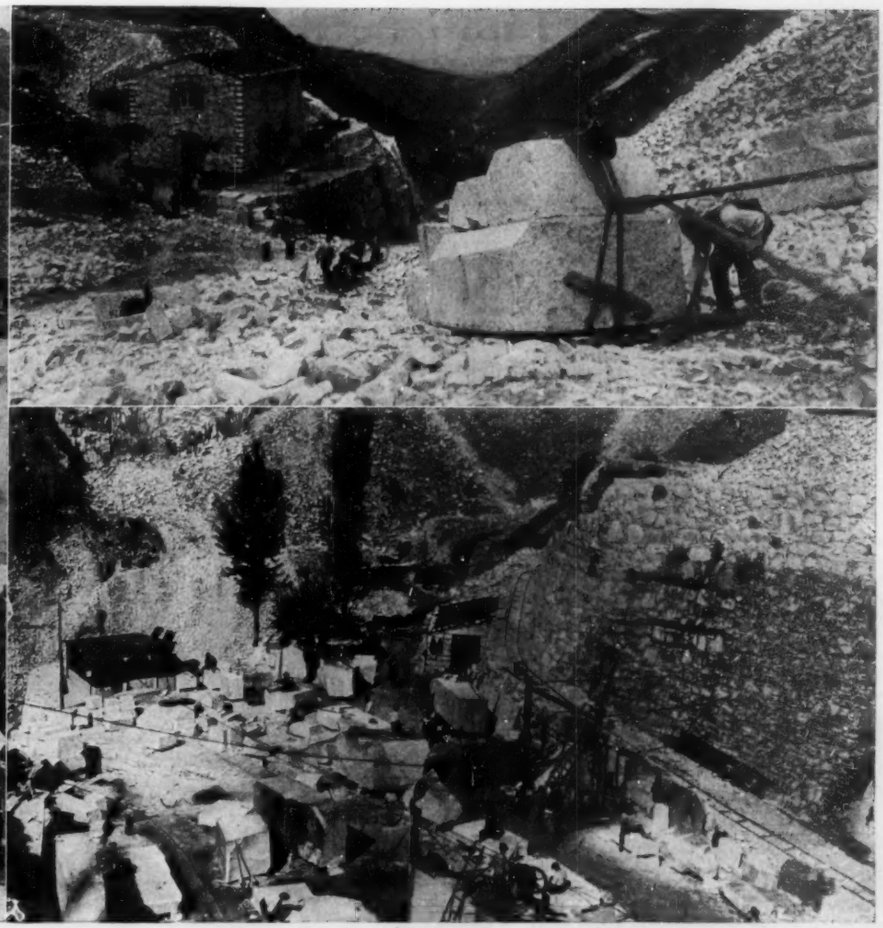
MODERN TRANSPORT INVADES THE QUARRIES

Automobile trucks now take the place of the thousands of slaves, mostly captives of war, whose labor worked these and other quarries in Roman times



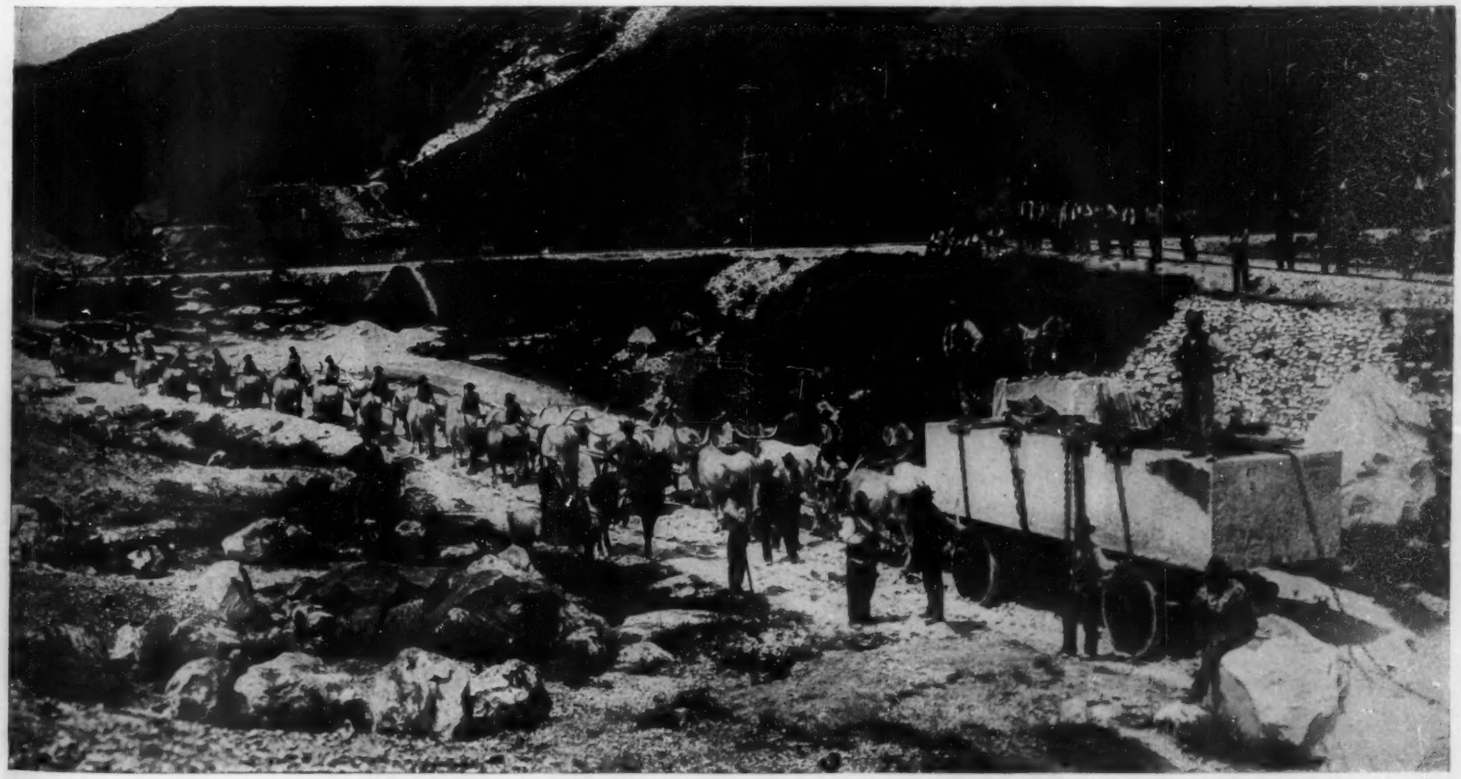
EVEN HOUSES ARE OF MARBLE

Small fragments of marble, even of the best quality, are so common in Carrara that anyone can build his house of them



GREAT BLOCKS DESTINED FOR WORKS OF ART

The Carrara marble is roughly dressed on the spot and then shipped to sculptors and builders all over the civilized world who use it in the production of beautiful works of art



AT TIMES THE ANCIENT MODE OF TRANSPORT STILL PROVES TO BE THE BEST

Although motor trucks and railroads are now used to handle the output of the quarries, some of the largest solid blocks are still hauled down from the hills for shipment on enormously strong wagons, drawn by spans of oxen, just as was done when Michelangelo was using the Carrara marble for his greatest works

Novel Devices for the Shop and the Home

A Department Devoted to Recently Invented Mechanical and Household Appliances

Conducted by Albert A. Hopkins

The clasp releases the cake

English Cake Pan

WE are apt to think that our English brethren lack invention when it comes to household articles but this is not the case as is shown by the illustration of the cake tin with a split rim. When the cake is baked, the pan is removed from the oven, the clasp is loosened and the cake easily released from the metal ring.

A Portable Piano

AN inventor has come forward with a piano which is so portable that it can be carried in an automobile with ease. The results obtained from this miniature piano are excellent although, of course, not comparable to those obtained from one with 88 notes. This piano is provided with a removable unit carrying the strings and action, another unit carrying keys of usual width and a third unit comprising the collapsable frame. It can be readily carried by one man from place to place and can be easily taken apart and packed in three bundles. It can be reassembled in a very short space of time. The sounding board, the strings, the damper, the hammers and the actuating rods for the hammers are all mounted as a single unit which may be placed between the side frames so as to, in itself, form the back of one half of the rear of the piano. The keys and the carrier upon which they are mounted form another unit which can be slid into place.

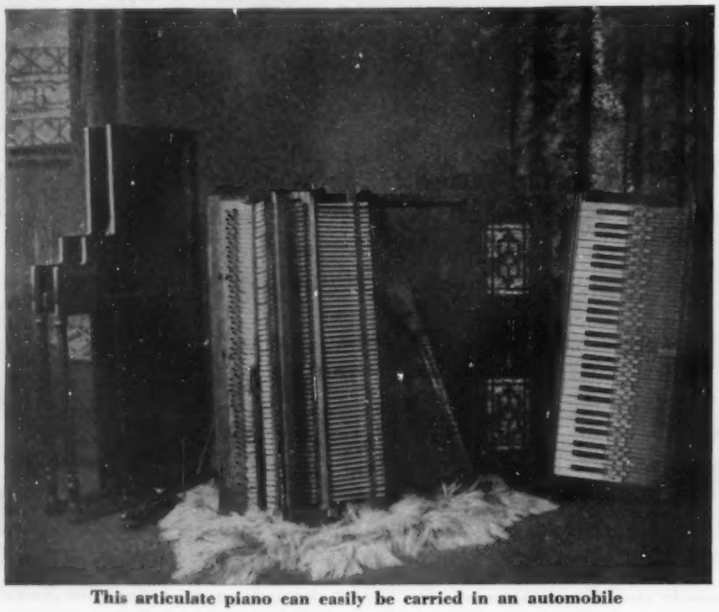
Finishing Concrete Roadway

ROADBUILDING is simplified by this machine. The concrete is deposited between steel side forms set for the proper width of the slab which is to be made. The finishing machine rides on these side forms. The concrete is roughly leveled by men with shovels, then the machine moves away under its own power, striking off the concrete to the proper level and giving it the correct crown for the road. Behind is the tamping board which helps eliminate a portion of the air and water in the concrete, giving a denser slab. Behind the tamping member is the belt or float. This mechanically smooths the pavement.

Eternal rest for old razor blades

The miniature piano is more than a toy although its range is small

A great labor saver in roadbuilding



This articulate piano can easily be carried in an automobile

Slipping the cake from the pan

Razor Blades in the Sleeper

CARELESS travelers were always throwing safety razor blades into the towel racks on sleeping cars causing serious cuts when the porters emptied the towel receptacle. To obviate this, the Pullman Company supplied a little bag for the waste blades, but the manufacturers complained that the blades would be sold by the porters and resharpened. Therefore, a slot was cut in the side walls and the blades were allowed to drop between the outer and inner skins of the car. In a short time, there would be nothing but a small mass of rust.

A Visible Corn-Popper

WITH the ordinary corn-popper, it is necessary to open the popper from time to time to note the progress of the bursting grain. With the device shown, popping is rendered easy as the corn is visible at all times.

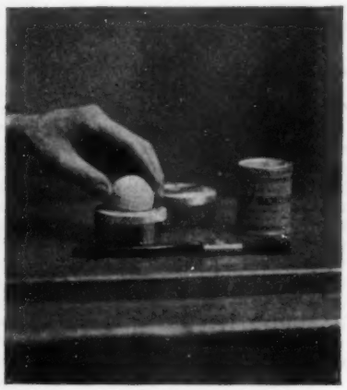
A glass cover for the popper

Placing ball in die

Re-covering Old Golf Balls

EVERY golf player would like to re-cover his old golf balls. An outfit has now been introduced which makes new golf balls out of old ones that have had the covers cut. Our illustrations show the sequence of operations.

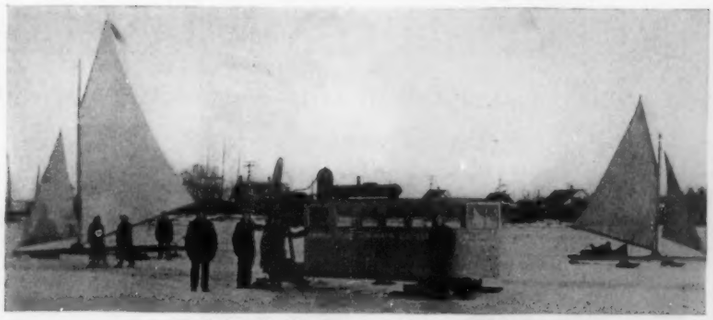
First the old cover of the ball is removed. A new cover which comes in two pieces, with the repair outfit, is placed on the old core. This is put in a two-piece die, which is then clamped tightly together so that the covers of the ball fit closely. Then the die is placed



Removing newly covered ball

in hot water. This unites the two parts of the new cover. The whole is removed and cooled, and the die is taken apart by means of thumb screws. The ball is removed, scraped to take off any uneven portion where the two parts of the cover meet. It is then painted and after drying thoroughly it is ready for use on the golf course.

Safe sanitary milk holder



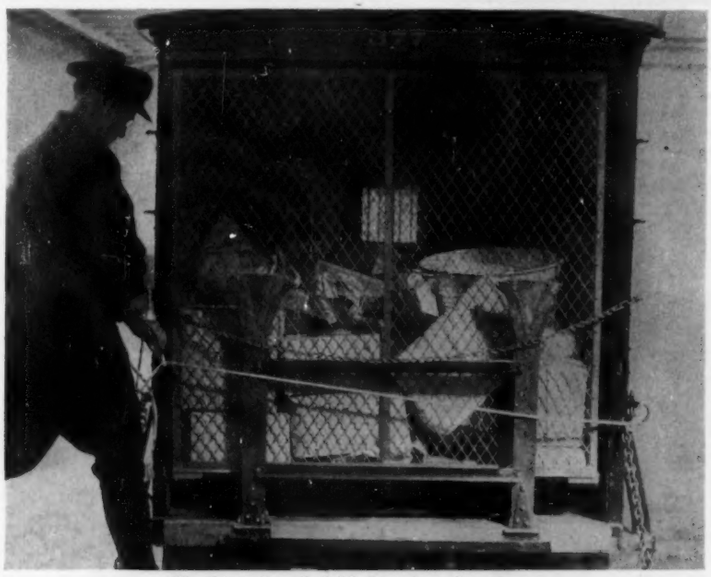
A hundred horsepower ice omnibus

Hinged Rack Facilitates the Removal of Package Cage

IN making delivery of packages for one of the large stores in San Francisco, a service company has had a number of cages built which fit into the body of the truck as shown in the illustration. On arrival at the sorting plant, the truck which carries the unloading platform where bulk may be broken.

An Ice Omnibus

THIS curious vehicle is capable of transporting ten passengers over the ice. It is moved by an airplane propeller of the "push" type and is capable of making high speed. The motor is of 100 horsepower.

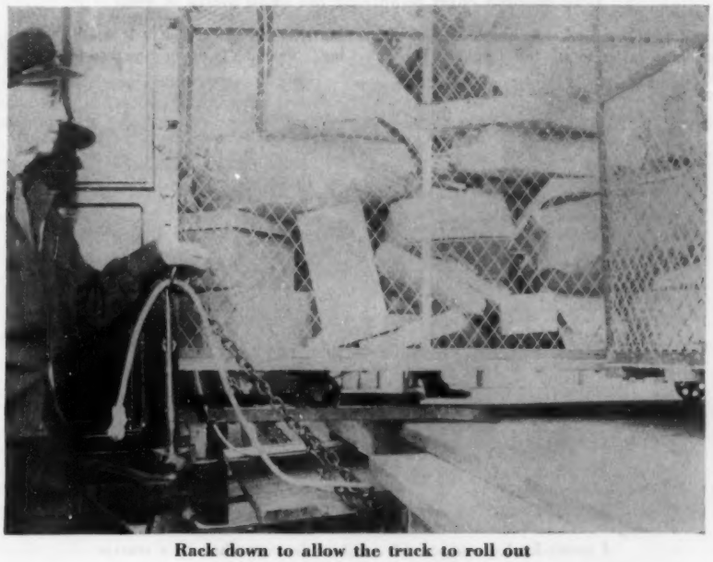


The hinged rack folded against the screen

the cage is backed up to the unloading platform. The cage is mounted on four casters. These run in a metal groove attached to the floor of the truck. When the cage is to be unloaded, the hinged racks shown at the back of the truck are lowered so that a continuous track is provided for wheeling the packages in the cage from the truck to

Clean Milk Insurance

CLEAN milk is assured by the use of a metal milk bottle container shown on this page. The paper caps are protected from dirt, dust and from dogs. It holds messages to the milkman, milk tickets, and keeps them protected from rain or snow. The device is very reasonable in price.



Rack down to allow the truck to roll out

Putting the die in hot water

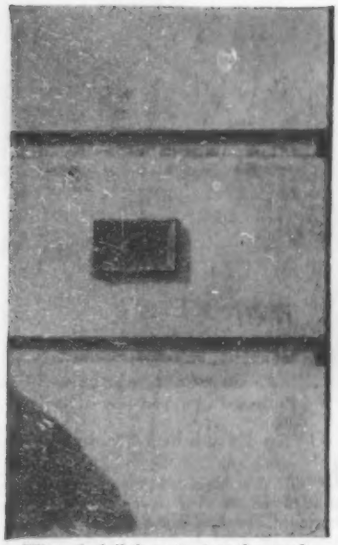
An Expanding Reamer

BY using the cylinder reamer shown on this page an unusual amount of flexibility of the blades is made possible. When expanded, the blades do not enter the cylinder wall after insertion in the cylinder and while the reamer is stationary, but rest firmly against it until the device is revolved. During the first quarter revolution of the reamer the blades are gradually fed to the full depth and are sustained there by the spring tension against the upper retaining collar. The expansion and contraction of the blades are effected by the longitudinal

Painting the ball with enamel

movement of a sliding spindle which is provided with two long, separate, tapered seats to support the blades. The movement of the spindle is brought about by adjusting the nut located at the top end of the reamer. This nut is graduated in order to record contraction or expansion in thousandths.

Expanding reamer for cylinders



"Peep-hole" for viewing the vault

Making It Hard for the Burglar

A BANK in Portland, Maine, has installed a periscope as a defense against bandits and burglars. The optical mechanism is concealed within the walls of the vault and has an outlet on the exterior of the building. A small "peep-hole" enables the policeman on the beat to see the interior of the bank vaults even though they may be below the street level. A system of lenses and prism enables one to see the entire interior as well as the entrance of the vault so that no one could even approach the door without being seen. The "peep-hole" is imbedded in bronze set in the masonry on the street level.

Saving the Soap

IN nearly every household, a considerable quantity of soap is wasted each year as almost anybody will refuse to use a small piece of soap. A device has now been introduced which does away with this waste. It turns small pieces of soap into powdered form, a little at a time as needed and uses it all to the last crumb. All members of the family can use the same cake of soap without the cake ever coming in contact with the hands. All you do is raise the lid of the soap holder and turn the handle. The soap is cut by knives to a powder. Any soap except the softer grades may be used.

A Self Contained Loader and Shovel

ONE man can efficiently operate this combination shovel and crane-loader built onto a tractor. In digging operations, the tractor moves ahead and the bumper forces the shovel into the pile of material. The massive rear axle of the tractor absorbs all the digging strains. A load may be dug, raised, swung and dumped in an average of thirteen seconds. This is possible because no unnecessary backing up and turning is required. As the shovel of the machine raises to its full height it knocks a clutch out and throws a brake on automatically.

Details of the mechanism for observing the vault

Cooking by Steam

THE cooking device which we show has been on the market for several years but it is so efficient that it is worth illustrating. Steaming is the best method of cooking many foods, as, for example, cereal, bread, macaroni, egg, milk and cheese dishes, fish and some meats. The device shown consists of three parts: a food pan which fits securely over a water pan and a cover which fits both. Holes near the top of the food pan admit steam directly in, upon and around the food. Herein lies the difference between the ordinary double boiler where the food pan simply extends down into the water pan. Drain holes in the rim permit the steam which condenses on the cover to drip back into the water pan.

Even children enjoy powdering the small pieces of soap

A steam double boiler

A Shaving Brush and Beard Softener

THIS shaving brush has three functions, first to prepare the face for the lather; second, to apply the lather itself; and third, to massage the face after shaving. The handle is set at right angles to the brush, thus keeping the lather away from the hands. After shaving, a delightful, healthful massage can be given by washing the lather off the rubber "fingers," dipping them in clean water, and rubbing over the face until the skin glows and tingles. Lastly, the lather brush should be thoroughly washed, given a few quick shakes and hung up to dry.

Celluloid for Draftsmen

THIN sheets of celluloid are coming into use as a substitute for tracing cloth as it has been found that this is especially useful for the recording of data, maps or diagrams, particularly those which are subject to frequent revision and much handling. The celluloid which is usually employed for this purpose has a matt surface on one side. The sheets are not rolled up but are kept flat so that they are easily stored in vertical filing cabinets or in large drawers. No separators are needed between the sheets of celluloid.

Applying the lather

A crane-loader and shovel combination attached to a tractor

Massaging the face

The Scientific American Digest

A Review of the Newest Developments in Science, Industry and Engineering

Conducted by Albert G. Ingalls

Talking Motion Pictures

In our July issue we described a new kind of motion pictures that talk (page 53). A wax disk, somewhat similar to the ordinary phonograph record, and bearing in its grooves the records of the incidental music of a moving picture, and some of the incidental sounds, was perfectly synchronized with the picture film.

Since then we have had the opportunity to see—and hear—these remarkable pictures at a private showing given in New York, by the Western Electric Company, and Warner Brothers Pictures, Inc., the two groups which have cooperated in the development of this new art. First we saw as well as heard Will Hayes, so-called "Czar of the Movies," making a short announcement concerning the future of the talking motion pictures. The synchronization between the lips and voice was perfect, while the voice and intonation as well as the other acoustic properties were as nearly perfect as a fine radio set, for example, would have rendered them. Then we saw a scene from "I' Pagliacci." The clown moved and sang in perfect unison, so that the illusion of his presence was well-nigh complete.

But odd as it may seem to the reader, the new method is not ordinarily to be employed for reproducing the voices of the actors of the motion pictures. This could be done, but it is not commonly desirable. People have become accustomed to keeping track of the plot through a study of the pantomime, and with the aid of sub-titles interspersed wherever necessary. By reproducing the speech of the actors the fine art of pantomime would be brought to naught and an element of the commonplace, a jarring note, would often be introduced. Therefore in a third moving picture which we witnessed, "Don Juan," with Barrymore as the star, the usual printed sub-titles were used. When, however, the wedding bells chimed in the picture their actual notes were reproduced by the speaking device, but at all other times the accompaniment was that of a full orchestra—in the present instance, that of the famed New York Philharmonic Orchestra of 103 pieces.

Thus, in effect, the talking moving pictures should bring the large picture houses of Broadway, with the splendid incidental music of their large orchestras, to much smaller communities. Certainly a picture is more thrilling, more enjoyable when thus accompanied, than one run off to the tune of a piano played by a bored musician. During the entire demonstration the acoustics were excellent. The material in the phonograph disks is much softer than in those used in commerce, and thus many objectionable qualities of the latter are largely eliminated. The sound is amplified by means of an apparatus similar to that used with radio sets, but more powerful, and it issues from special concealed megaphones.

The mechanical apparatus is remarkably simple. The shaft that drives the film is positively geared to the shaft that drives the wax record. Operators, we are informed, are to be trained by the manufacturers, the course requiring a few weeks. The entire equipment is said to cost less than that of a pipe organ, and regular service is to be begun as soon as the new equipment is ready for distribution.

Thus one more advance in the art of entertaining is initiated, and we may see the last of the squeaky fiddle and ill-tuned piano of the old-fashioned type of moving picture house.

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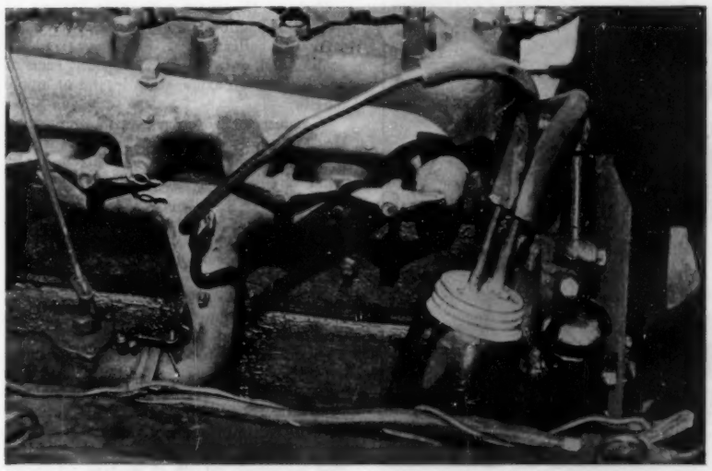
The oil rectifier as incorporated in a Packard Eight. The inventor is shown pointing to the rectifier



The original oil rectifier, described on this page, and used in the early experiments, was nothing more than a Mason fruit jar, installed on a Ford car

Keeping Gasoline Out of the Crankcase

As every motorist knows, oil pumping in an engine is caused by the vacuum in the combustion chamber pulling oil up past the piston rings. How to prevent this costly and damaging fault was an unsolved problem that harassed automotive engineers for a quarter century. Six years ago, it developed that if the same vacuum could be created in the crankcase, *below* the pistons, the passage of the oil upward would be stopped and the oil pumping eliminated.

Experiments along this line disclosed a new objective vastly more important and interesting than the original. Not only could oil pumping be prevented, but conversely; *all* oil troubles could be eliminted by keeping *dilution* out of the crankcase.

The evolution of this idea and its development can best be described by briefly tracing the experimental work of the past six years—a history which aptly demonstrates how failures in experimentation can often be turned into eventual success.

In the first attempts to place a vacuum in the crankcase, a vacuum pump was used. But inasmuch as the crankcase could not be made air tight, a very large pump was required. It was soon discovered that this large pump pulled oil from the back main bearing of the engine, and bearing failures resulted. The theory was wrong.

Further experiments proved that a vacuum could be applied directly to the pistons by drilling a hole through the cylinder wall at such a point that it would register with the lower piston ring when the piston was at the bottom of its stroke. Applied here, the vacuum of the intake suction would be sufficient to draw off the oil on its way up to the combustion chamber.

In order that the oil might be easily withdrawn through the hole in the cylinder wall, a groove was cut around the piston immediately beneath the lower ring. This should trap the excess oil and permit the intake suction to remove it each time the groove came opposite the hole in the cylinder wall.

Weeks of experimenting finally proved that this method was not removing enough of the surplus oil—for the same reason that a liquid cannot be poured rapidly from a sealed can in which but one hole has been punched. An inlet for air, as well as an outlet for oil, was needed. This difficulty was surmounted by drilling a small "bleeder" hole through the wall of the piston, opposite the hole in the cylinder wall.

At last, enough oil could be removed greatly to curtail engine smoking. The first objective was achieved.

Having found that the excess oil could be removed from the piston, thus preventing it from reaching the combustion chamber, the next problem was what to do with it.

At first, an ordinary Mason fruit jar was used to collect the oil removed from the pistons. The first time this jar was tested on a Ford car, about five miles had been run when the car suddenly began to smoke excessively. The oil removed from the pistons was being carried into the intake manifold. The quart jar was full! (Of course, a large percentage of the contents was gasoline trapped on its way down to the crankcase, but the importance of this fact was not realized at the time.) After considerable experimenting, an automatic device was developed to replace the Mason jar and to allow the surplus oil to be returned to the crankcase by gravity.

The system was now fairly successful. But it did not accomplish the economy nor obtain the oil mileage that had been hoped for, particularly at high engine speeds. Finally, the idea was hit upon of removing the oil, not from an extra groove cut around the piston, but from behind the lower piston ring or the bottom of the lower piston ring groove. Removing the oil from back of the ring proved so successful that it was made a permanent feature.

Some of the first test installations were made on tractors, to determine just what oil saving could be achieved on that type of internal combustion engine. The primary object was to eliminate oil pumping and its train of evils. It was discovered, however, that after these tractor installations ran a few hours, the oil did not thin out so readily. Dilution was being cut down automatically because the more volatile elements in the mixture drawn from the pistons were being vaporized, drawn back into the combustion chamber and consumed, while the heavier liquid oil was returned to the crankcase. Here the idea of systematically preventing crankcase dilution was born.

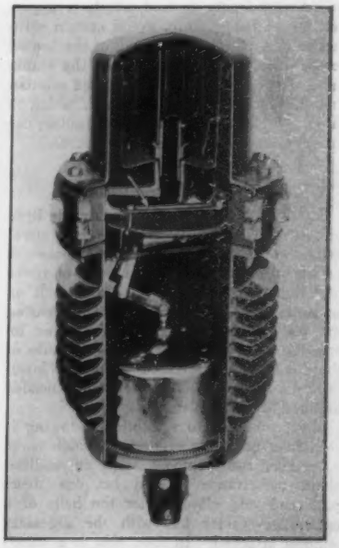
Installations using heat to distill the mixture were now made on six different tractors, with excellent results. It was found that instead of changing the oil every thirty hours, tractor engines would operate as long as 350 hours with the oil remaining in good condition.

At this point in the development, it was suggested that a more practical plan of eliminating crankcase dilution would be to remove the oil from the crankcase itself, instead of from the pistons, and then to pass it through the rectifier or separating device. This method was tried, but with little headway. Dilution passed by the pistons into the crankcase just about as rapidly as it could be removed.

Abandoning all experiments with this type of rectifying system, the first idea was again tried of removing the contaminated oil from the pistons, heating it, and then conducting it to the rectifier for purification. In other words, it was far more practical to *prevent* crankcase dilution than to attempt to cure it.

Next the rectifier was tested on a standard automobile engine. This test was made indoors, under ideal temperature conditions. A mixture of 35 per cent kerosene, 10 per cent water and 55 per cent oil was placed in the crankcase. In two hours, the water was gone, and in ten hours the dilution was down to 5 per cent. Apparently, the device had been perfected.

But when the same engine was taken outside and placed in a chassis, the results were disappointing. Dilution could not be prevented except when the car was operating at high speeds and when the motor was hot.



Cut-away section of the rectifier. The white arrow indicates the thermostatic valve which keeps the oil cool

The caterpillar tugboat towing a derrick float. The two separate hulls may be seen beneath the deck. The wash is from the endless chain contrivance which lies between them and carries the perforated paddles

Further experiments showed that the method of heating the contaminated oil at one point and then conducting it to the rectifier for separation at another was entirely wrong. The vaporized impurities had a tendency to recondense and again pass into the oil. It was then decided to combine the heater and the rectifier. With a rectifier of this nature, a test was run on a Ford car in which the fuel tank was filled with kerosene. Gasoline for starting only was drawn from an auxiliary tank. This car was run about 500 miles on kerosene alone, with a maximum dilution of 6 per cent. Combining the rectifier and heater had proved to be the ideal method of removing the dilution. This was the correct solution.

One problem still remained. While maintaining sufficiently high temperature in the rectifier to separate the volatile gases from the oil, it was necessary to prevent the oil itself from becoming overheated. A thermostat was finally devised which at a predetermined temperature, would open a valve and permit the oil to drain out of the heated compartment of the rectifier into the crankcase. This proved to be the desired solution and the adoption of this method, which is called the Skinner system, by the leading car manufacturers, followed in due course.

* * *

A Caterpillar Tugboat

SHALLOW water navigation has made little progress since the days of the old, stern-paddle-wheel steamers. The reason is readily apparent in that the units of transportation must be kept relatively small on account of the impossibility of increasing the power—which in this case means increasing the size of the wheels—because of the limitations prescribed by wheel losses in shallow water, where power is most needed because of hull resistance.

What promises to revolutionize towing is seen in a new type of tugboat which is, in substance, two pontoons with an endless-chain contrivance located between them, patterned very closely after the belts of a caterpillar tractor but with the necessary paddles attached. In fact, this is a water-tractor towboat. The advantage of a horizontal thrust throughout the entire length of the belt is demonstrated in the towing ability of this novel boat. Perforations in the paddles give the accumulative effect of the same principles as were explained in connection with an oar on page 368, June, 1925, issue of the Scientific American. The great advantage here is that as these paddles slip through the water, the holes or perforations therein, allow enough water to pass through them so that one paddle does not rob the other of the amount of water required to give it sufficient grip to develop power. There is absolutely no suction as close as six inches in front of these paddles, all the water being supplied from underneath. A solid paddle operating on an endless chain becomes very inefficient when the slippage through the water is more than four miles per hour. Here apparently a vacuum is created in front of the boat and the water rushes in between the pontoons almost as rapidly as it comes out at the back. With the perforations, however, the point has not yet been found where any power is lost, no matter how fast the paddles slip through the water.

Another point in favor of the perforated paddle and the direct backward thrust is that when the boat is in operation where the paddles come within ten inches of the bottom, the sand or mud is not disturbed. This would tend to show that retarding eddies are not set up by the "churning" of the paddles.

Here is one of the strong features of this type of propulsion and it explains why operation is more efficient in shallow water than with the old type propeller or even the radial wheel.

* * *

"The Splendour of the Heavens," a Notable New Book

HAVING completed a careful reading of the entire 976 pages of "The Splendour of the Heavens" the writer feels at a loss for adequate superlatives with which to characterize it.

This book is called "a popular, authoritative astronomy." Each of these words appears to have been thoughtfully chosen. It is popular without being too popular. It is as authoritative as one has a right to expect when told that every one of its 19 co-authors is a member of the *Royal Astronomical Society*, and that the secretary of that famed old association of astronomers acted as one of its editors. It is an astronomy in that it covers practically all the ground that a general astronomy should cover (except the purely study-book subject of astronomical reference points, lines and positions). It is not, however, a text book, but rather a book to be read, chapter by chapter, with keen interest.

Perhaps the most noticeable feature of "The Splendour of the Heavens" is its remarkable collection of astronomical photographs and drawings, 524 of them, each of which bears an explanatory legend of ample length.

We must not, however, give the impression that "The Splendour of the Heavens" is only a picture book. The text is far from superficial, although it is sufficiently non-technical for the comprehension of the average intelligent person. After reading it one ought to have a pretty good idea of the whole field of astronomy, without, of course, having delved too deeply into any one part of it.

Of the two handsome volumes the first is entirely devoted to the solar system, including well-rounded discussions of the present status of the problems of Mars, Venus, the moon, and of comets and falling stars. Here as elsewhere each contributing author was especially chosen because he had previously specialized on his subject.

The second volume is chiefly devoted to that marvelous rebirth of modern astronomy of the present century, which has carried our knowledge of the universe almost infinitely beyond the neighborhood of our own solar system. A few of the interesting chapter headings are: Finding the Scale of Space; The Message of Starlight (brief explanation of the immense significance of stellar spectroscopy); Star Clusters and Nebulae; The Structure of the Universe; The Amateur at Work (53 pages concerning worth-while work which the amateur astronomer can do).

The last 140 pages of the second volume are working pages for the amateur who uses a small telescope. The map of the moon, reproduced in 25 sections, is undoubtedly the best in existence, while 525 lunar formations are named and described in notes. The 36 large-scale charts of the constellations constitute a star atlas in themselves. All of the "show" objects of the heavens are described and located, and there are lists of interesting objects, such as variable stars, double stars, red stars, nebulae, and so on.

"The Splendour of the Heavens" (McBride, New York, 1925) is well suited to those who are making telescopes in connection with the telescope-making campaign which is now being carried on by the Scientific American. It would whet their appetites for astronomy and teach them what uses they may expect of their telescopes. It is somewhat expensive ($12.50, plus postage) but the large size of the work (the pages measure eight by eleven inches), its fine binding, smooth paper and general attractiveness make it well worth the price asked by the publishers.

One might safely challenge anyone, no matter what his previous training or present interests, to open either volume without poring over it for hours.

* * *

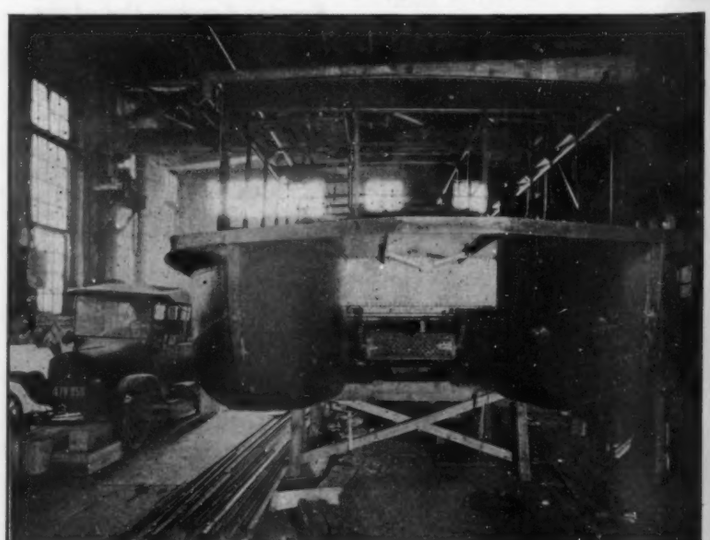
A Study of the Dardanelles Expedition

MANY are the books which have been written for the purpose of embodying the lessons of the World War, and doubtless there will be many more. Here and there in this ever-accumulating literature, there stands out a work which, because of its clarity, forcefulness and the analytical power displayed, carries particular value. In such a class belongs "The Dardanelles Expedition"—a condensed but complete analysis of that ill-fated venture, written by Captain W. D. Puleston, U. S. N.

So far as the civilian reader is concerned, the fault of much of the war literature is its bulkiness and over-elaboration of detail; but to any one who is looking for a concise, clear and thoroughly understandable story of the complicated Dardanelles expedition we heartily commend this book.

In the preface to the book, Captain Puleston writes. "This account of the Dardanelles expedition is primarily intended for army and naval officers; but it is hoped that it will be found worthy of the brief notice of American statesmen who may be required to direct the destinies of our country in time of war. All three classes are busy men, so the narrative has been compressed and fully illustrated in order that its contents can be quickly understood."

The work commences with a brief but comprehensive review of the history of the political background of the war, including a review of the history of Constantinople which was, of course, the great objective of the Dardanelles expedition. It then shows the events which led up to the various naval attacks with which the campaign opened. Then, in their order, follow descriptions of the successive attempts to silence the forts and force the passage of the Straits. The most thrilling part of this narrative deals with the landing of the British and French troops and the curious but unavailing attempts of the army to force its way through the hot and arid defiles and obtain possession of various commanding positions. The work ends with the withdrawal of the British forces under the cover of night without the loss of a single man.



Forward end of the caterpillar tugboat. One of the perforated paddles, driven by means of sprocket chains, shows between the two hulls. The idea is ancient, but the application is new and has been found efficient

A notable feature of the work which makes it possible to follow both the naval and landing operations with full understanding, is the large number of specially prepared maps which are included with the text, each map being in juxtaposition to the chapters that treat of the particular map concerned.

The Dardanelles expedition was a major operation, even in a war as great as this. The British employed over 400,000 men during the campaign, of whom they lost 120,000 and to this must be added the French losses, figures of which are not available. The Turks employed 800,000 men and lost 218,000. There is a touch of humor in the following paragraph at the close of the chapter on the evacuation of Gallipoli. "The southern Turkish forces twitted the northern forces for permitting the British to escape unscathed, to which the northerners responded, 'You know now Helles is about to be evacuated. Let's see you stop them!' On January 9th, in spite of repeated warnings and some last-minute bad weather, the southern Turks were as powerless as their northern brothers to prevent the departure of the British from Helles."

The book which is handsomely bound in red buckram contains 154 pages and 68 plates. The price is $2.50 and the work is published by the United States Naval Institute, Annapolis, Maryland.

* * *

New Proof That the Sun's Heat Varies

A DEVELOPMENT which bids fair to rank high in weather forecasting is announced in the latest issue of the Monthly Weather Review of the United States Weather Bureau, by Dr. Charles G. Abbot of the Smithsonian Institution, says the Scientific News Service of that institution. That development is the discovery of a new and simple proof by Dr. Abbot that the amount of heat given off by the sun from day to day and from year to year varies.

If the proof is final—and it seems irrefutable—there can be no further question that the sun is a real factor in the daily and yearly weather changes. Exact appraisal of its value for long-range weather forecasting awaits only the further perfection of measurements of solar variation and world weather. At all events, an essential element new to weather forecasting has been discovered and proved. Its application is only a matter of research and time.

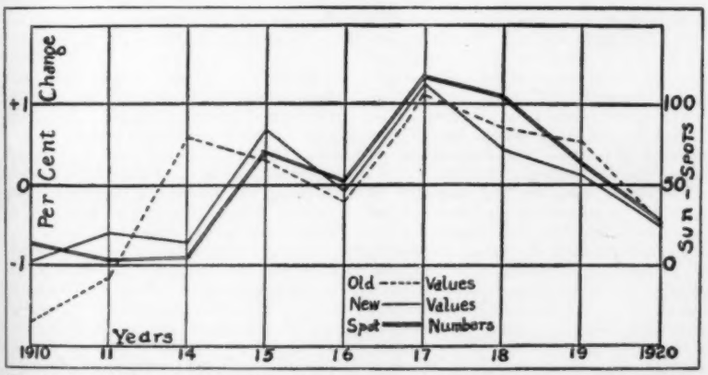
For 30 years, Dr. Abbot has been investigating the sun and measuring the heat it sends to the earth. In 1903 he surmised from his results for previous years that the amount of that heat varied. Urged on by that clue and its great significance to mankind if true, he has spent the intervening years in elaborate measurements of solar radiation in many parts of the world: at Mount Wilson and Mount Whitney, California; at Bassour, Algeria; at Mount Harqua Hala, Arizona, and Mount Montezuma in the nitrate desert of Chile. He developed instruments capable of measuring a millionth of a degree change in temperature, and other instruments of the greatest complexity and usefulness to be used in connection with his measuring instruments for standardizing and for computing results.

The outcome of all this work was to justify his belief in the truth of his theory. But some of the most prominent weather men in the world disagreed with Dr. Abbot. They did not doubt that weather would change if the sun's heat varied, but they were not convinced by Dr. Abbot's work that the sun's heat does vary.

They based their criticism on the difficulty of measuring the sun's heat accurately through the atmosphere which intervenes between the earth and the sun. This atmosphere is so variable in transparency and in its content of water vapor and dust that these scientists feared Dr. Abbot was misled. They believed that the variations he found were due to atmospheric and not to solar changes.

The proof which Dr. Abbot now announces appears to finally refute these criticisms and to leave no further doubt of the variability of solar radiation.

The essence of this proof lies in a comparison of measurements of solar radiation made at times when the atmosphere is practically identically the same. It is obvious that if the atmosphere is the same and the instruments are correct any changes must mean differences in the amount of heat given off by the sun.



Visual proof that the intensity of the heat radiated by the sun varies. The dotted line shows the changes for Julys 1910-20, according to the solar constant values already published by the Smithsonian Institution. The black line shows the variation newly determined from measurements made on days when atmospheric conditions were identical. Double line shows variation of sunspot numbers. The similarity of the lines establishes the claims of Dr. Abbot

Dr. Abbot selected measurements made in the month of July for the years 1910 to 1920, omitting the years 1912 and 1913 because the volcano of Mount Katmai in Alaska filled the atmsophere of the whole northern hemisphere with dust in those years. During all these years Dr. Abbot and his assistant, Mr. L. B. Aldrich, had measured the sun from the same observatory on Mount Wilson, California. They used the same instruments throughout, and these instruments were regularly tested against standards and found unchanged.

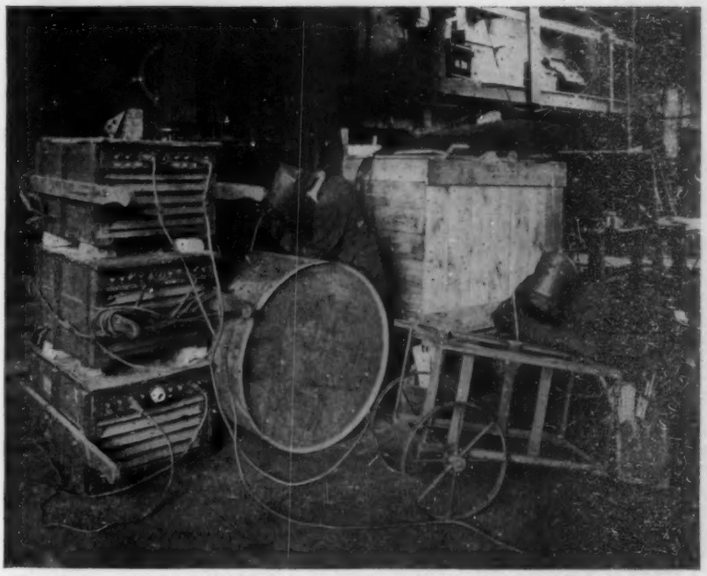
From the measurements made in these months, he selected the days when the atmospheric transparency and its content of water vapor were practically the same, dividing these into comparable groups. All days in any year in which atmospheric conditions were not practically identical to those in other years he discarded.

He then plotted the measurements of the total quantity of heat received at the earth's surface. On the same paper he plotted the solar constant values for these years as previously published. (These solar constant values are the result of the measurements of the total quantity of heat received at the earth's surface, corrected by measurements of the loss of heat through the earth's atmosphere so as to indicate what would be found outside it—on the moon, for instance.) How closely the two results parallel one another is shown by the accompanying chart.

As a further proof of the accuracy of his measurements of the variability of solar radiation, Dr. Abbot plotted the average number of sun spots for Julys of the same years on the same paper. The harmony is again apparent.

Such is a simplified account of the proof that the radiation from the sun varies over a long period of time closely in harmony with the sun's visible evidences of activity. But Dr. Abbot did not stop here. He used a slight modification of the same method to show that short interval changes within the individual months are also verified by this simple process. It seems as if these demonstrations should convince meteorologists that the time is ripe to test the effect of solar changes on the weather.

With this great step accomplished the next move is to make the daily measurements of solar radiation as accurate as is humanly possible. To help accomplish this, the National Geographic Society has given $55,000 to establish a solar observatory at Mount Brukkaros in Southwest Africa to cooperate with Dr. Abbot's two existing stations in California and Chile. To insure that at least one accurate measurement will be made for every day in the year, a fourth station is needed in the northern section of the Eastern Hemisphere.



The compact, portable welding equipment with which the repair job shown below was performed

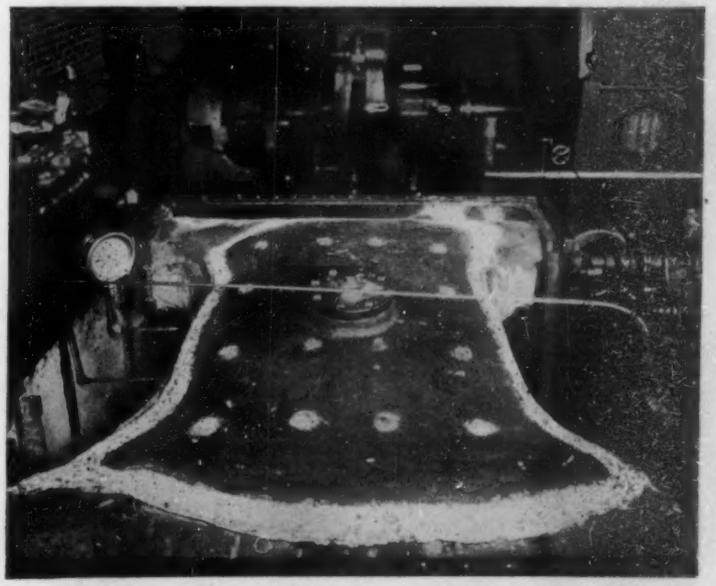
* * *

An Interesting Cylinder Repair

RECENTLY, in a plant at Little Ferry, New Jersey, the low pressure cylinder of a 900-horsepower engine was subject to an accident in which the entire top of the cylinder was blown off.

It appears that by some unknown means, the full boiler pressure was put on the low-pressure cylinder, with the result that the cast-iron top, one and one-half inches thick, was blown into several fragments and entirely ruined. Fortunately, no one was seriously hurt although five men were in the engine room at the time. To get a new cylinder would have taken months.

Considerable interest attaches to the repair work on this job, both because of the short time taken to do it and because of some of the details of the weld. Fortunately, the head official of the inspection department of the insurance company which carried the risk on the broken engine, had had considerable experience with arc welding. He therefore had the courage to make this repair by that process. His faith in cast-iron welding had been built on the use on several jobs of transformer welders with alternating current, so he turned to this type of apparatus, renting two welders, together with their operators.



How a large, broken cylinder-head was repaired by electric welding

The top of the cylinder was completely welded between Friday morning, March 26, and Sunday afternoon, March 28, and the engine was put back in operation on Monday morning at 7:00 A. M. Our photograph shows the entire patch, which measured 42 x 62 inches and had an irregular contour.

A group of telescope enthusiasts gathered in a semi-circle around one of the new, Springfield mountings (which is nearly obscured in the picture), listening to a demonstration. Just over the mountain ridge in the dim background stands the old Coolidge homestead. All the neighboring mountains are thickly forested

A special steel casting had to be made from a pattern which was first fitted over the break itself. This casting was larger than the break, and the outer edge of the break was chipped so as to form the necessary bevel to weld clear through. This casting was stay-bolted securely by means of one-eighth inch rods welded into its top surface with the proper bevel. The cast-iron break was studded with steel all the way around. The cracks which extended from the break were also studded. All was now welded by the alternare process. The entire job was caulked, in order to relieve the strains.

When the pressure test was applied, several leaks were located in the cast iron. These were stopped by caulking, as were two leaks in the patch casting itself. These leaks were probably due to the speed with which this casting has been made. They were cut out and rewelded. The engine is now in service just as it was before the accident, after considerable saving in time and money, not to mention the saving of the loss to the community which would have otherwise resulted by shutting down the plant for any considerable length of time.

* * *

Telescopes

WERE the present writer to follow his inclinations he would be likely to fill the entire space allotted to the Digest, with matters pertaining to amateur telescope making. The campaign for the popularization of this interesting work has brought better results than we anticipated. More than twelve hundred would-be telescope makers have been traced since we began this campaign with the publication of Mr. Porter's two articles last February and March, and followed with the publication of the book, "Amateur Telescope Making."

The postcard invitation which was sent out

No effort has yet been made to organize the telescope makers nationally, although local groups have been formed in a few cities. "The Rocky Mountain Amateur Telescope Makers Club" has been organized in Denver, it having originally been discovered there that several heads were better than one, and that a man who is an expert machinist but not a scientist could help another man who is a scientist but not an expert machinist, the two turning out an excellent telescope which neither could turn out so well alone.

In the city of Los Angeles alone more than 50 beginners have been traced. Possibly a club will be organized there, if a telescope maker having a penchant for organization can be found to do the work. Everywhere the spirit of the amateur telescope maker is excellent, and it generally turns out that when two of them meet, all differences dissolve in favor of the common bond of interest.

Here it might not be badly out of place to state that it is altogether proper to address the telescope enthusiast as a "T. N.," this having been the custom for many years among those few who have previously followed this work. T. N. stands for "telescope nut," and is the fraternal or brotherly loving form of address between true enthusiasts. For the benefit of those who have not yet been inoculated with the germ of the telescope making disease, it should be said that once the inoculation has "taken," the spell lasts for many years. A man sets out thinking he will make a single telescope, for the purpose of learning the elements of astronomy. He is apt to find, however, that this telescope is only his first, and that he has found a hobby that will pursue him all his life. Indeed, the writer corresponds with one T. N. who at 78, after having suffered a stroke of paralysis which incapacitated one arm, is now building a machine for making a mirror.

Our mail shows that most of the amateurs have made out well in their efforts. Perplexities have arisen, of course, but work which involved no troubles would have little inherent interest. One is especially impressed by the existence in this country of large numbers of people, who, while engaged in all kinds of occupations besides the mechanical, are nevertheless expert mechanics. Already in July, the photographs of most creditably built instruments, with their descriptions, are beginning to reach us. Two that we hope to describe next month are especially trim and workmanlike. When winter comes, and athletics, golf, fishing and other summer sports are laid aside, it is likely that many more will begin building their telescopes than have done so already.

One most interesting aspect of the new movement was the gathering of a group of invited T.Ns. at *Stellafane*, Springfield, Vermont, over the week-end of the Fourth of July. Invitations were sent out by the "Telescope Makers of Springfield" (which, by the way, is an amateur, not a business organization) and nearly 30 enthusiasts from several states made the trip to Vermont in order to convene, rub elbows and talk telescope making with their confreres. One T. N. who could not be present writes as follows: "Oh, it must be so delightful to get away from all these 'safe, sane and conservative' people for a little while and get with a bunch of cranks, all as crazy as one's self. Then to see a lot of telescopes and talk with their makers, what could be more heavenly? I am glad the skies favored you with a smile."

Mutual introductions having been exchanged, the amateur visitors at Springfield were first initiated into the mysteries of silvering mirrors. This is an art which has long been regarded as secret. If such has ever been the case, the secret is now out, for Russell W. Porter, leading spirit of the "Telescope Makers of Springfield," demonstrated before the visitors that it could be done in about half an hour, providing the conditions were right. The mirror is silvered in an enamelled pan about two inches greater in diameter than the disk itself. It must be handled with rubber gloves, as the least trace of saltiness from the skin, or of oil, results in failure. The pan is kept in motion during the process, which is complete when black blobs appear. The silver coating is usually deposited in less than five minutes. However, even old hands at silvering frequently "fall down" on this job, so the amateur who fails to obtain a fine coating at first need not be at all discouraged. Persistence and care will soon result in the desired perfect surface.

The visiting amateurs next inspected an apparatus for performing the knife-edge test by means of an electrically illuminated device invented by Mr. J. Watson Thompson, an attorney, of Cambridge, Maryland. Ordinarily this test has been performed with the aid of an oil lamp, which, however, has many objectionable qualities, one of which is the blistering of the face of the amateur who must place his eye near it. When an attempt is made to substitute an ordinary electric lamp for the oil lamp, the pinhole in the metal chimney acts in the same way as the "lens" of an old-fashioned pinhole camera. It throws a bright, inverted image of the filament in the mirror, illuminating it unevenly. But after frosting the exterior of a 115-volt candelabrum lamp by rubbing it with a curved strip of thin metal with some medium-sized carborundum between the two, Mr. Thompson succeeded in diffusing the light emitted by the pinhole so that the electric lamp serves as well as an oil lamp. The cylindrical bulb is lowered, upside down, into a metal cylinder having the regular pinhole, but it is well to insert some resistance in series with the lamp, since the confinement of the latter within the tube results otherwise in overheating its filament and a "burn-out" soon follows, necessitating the preparation of a new bulb.

Porter's Springfield Mounting, on a permanent base in front of *Stellafane*. Facing the camera, is Wilbur Perry who became a genius at mirror making while still a youth

Among the visitors at Springfield were three groups from various laboratories of the General Electric Company. These men were interested in telescope making on their own account. One man from the research department of the Navy came from Norfolk, Virginia. A number of interested young men camped out in a tent pitched near the conifers that partly surround *Stellafane*.

Saturday, July 3, the entire party of telescope enthusiasts was transported to the top of the mountain on which the clubhouse-observatory known as *Stellafane*, (described in the Scientific American last November) is situated. Telescopes were in evidence everywhere and these were eagerly examined, tried out on terrestrial objects and criticized. Some of the visitors next opened bags and brought out parts of their own work—mirrors and newly devised apparatus for testing them; also samples of pitch and abrasives which had proved especially efficacious.

Before dark the laureate-cook of the "Telescope Makers of Springfield" announced supper. What a supper it was! Mr. Redfield, who unwillingly consented to be hauled out of doors and posed for the picture shown on these pages, is king of the

(Continued on page 214)

Amateur astronomers gathered in little knots on the stone platform in front of *Stellafane*, "talking it over." Three telescopes show in the photograph

kitchen at *Stellafane*. He, like the rest, has made his telescope. He also makes johnny cake and enjoys cooking for the rest of the members. On this occasion he fed 29 and fed them to utter completion. This number was greater than he had ever fed before at *Stellafane*. "But," he remarked, whimsically, "when I get a little older I will probably do better."

Supper over, the amateurs were confronted by the night, for plans had been laid to stay up, like the traditional astronomer, until daybreak. The stars came out in myriads. Even the Milky Way, which the writer, living in a suburb of New York, has not even glimpsed in three years, owing to the haze and glare of the metropolis, showed brilliantly from the top of this Vermont mountain. Half, perhaps, of the visitors spent the night at the various telescopes that were scattered about outside of *Stellafane*. The other half remained indoors around a long table, arguing about this and that, and the theory of relativity and the "whichness of the why."

Saturn's rings were, of course, the show piece of the early evening. Later in the night came Jupiter, with three satellites

Mr. Redfield, laureate-cook of the "Telescope Makers of Springfield," author of the verses at the right, and senior member of the club

easily visible and one in transit across the face of his disk. Then came Mars, ruddy but poorly visible due to temporary atmospheric conditions. The moon followed as dawn approached, and finally Venus, brilliant, white, dazzling, rose over the mountain ridge in the east.

Inside the *Fane*, as the early hours of the morning approached, some of the visitors could be seen stretched out on cots, snatching catnaps between the frequent outbursts of a group of mathematical "sharks" who, it appeared, had raked over the whole science of mathematics in search of unusual problems about which to wrangle. They had forgotten astronomy, telescope making, everything, while they proved by several methods that two equals one, or discussed some equally abstruse matter. About every five minutes the sleepers were rudely awakened by the resonant voice of one man whose best form of argument was blunt contradiction.

The following day, the Fourth of July, was given over to further discussion. John Pierce, one of the leading lights of the Springfield group, gave a talk on the making of small lenses while the visitors sat in the shade of a row of deep green spruce trees which formed the edge of the primeval forest that covers the top of the mountain. Then Mr. E. H. Redfield, the laureate-cook, all decked out like a professional chef, stood on a tree stump and recited his famous verses about an eventful trip taken by the "Telescope Makers of Springfield."

The Telescope Maker's Dream

I dreamed that the Springfield Telescope club
Took a trip to the planet Mars,
And established ourselves on a mountain top
From which to view the stars.

That we carried a monster telescope,
A 'scope of most wonderful power,
And watched the stars and worlds roll by,
For many a countless hour.

And the sights we saw in realms beyond,
The vision of this world's eyes,
Were a ceaseless wonder and endless source
Of pleasure and surprise.

When the people of Mars inquired who we were,
And where was the land of our birth,
We turned that telescope around,
'Til it pointed to the earth.

And told them to look and see for themselves,
The land from whence we came,
And if all went well we hoped to return
To our native land again.

And when they had looked to their hearts content,
And examined the whole world o'er,
They said such a wonderful telescope
They had never seen before.

They saw great cities and towns on the land,
And ships that sail on the sea,
And questioned us closely of all that they saw,
And wondered that such things could be.

Then a wise old professor said, "Tell me I pray,
"What are those black bugs that I see
"That run 'round so lively and in such great droves?
"They're a new kind of insect to me."

"Please tell me their name and habits of life;
"For we have no such insects on Mars."
Mr. Fullam spoke up and said: "My dear sir,
"Those insects are Henry Ford cars."

We dwelt with those people a year and a day,
And found them a people of worth;
But then we were homesick and thought it was time
That we should return to the earth.

Of our journey to earth I have nothing to tell;
I felt a hard bump on my head—
I suddenly 'woke—'twas the end of my dream—
And found I had rolled out of bed!

On the same afternoon the amateurs, tired and sleepy, but filled with many impressions about telescopes, optics, mirrors, prisms and no end of other similar things, made a tour about the village of Springfield, inspecting five telescopes which were mounted in the dooryards of their owners, instead of on the mountaintop at *Stellafane*. Some of these have been described in the Scientific American and others will be described in future issues.

Through one, that of Oscar Marshall, the star Sirius was shown to the visitors in the blaze of the afternoon sun. While there is nothing remarkable about this feat, it nearly always impresses the tyro quite visibly.

After three years of this work the fun of making telescopes has not abated in Springfield. One gets the impression that the little Vermont community fairly bristles with telescopes made by the amateurs. It is expected that before long the entire United States will bristle similarly. And next summer, it is hoped, a larger number of amateurs will visit the TNs' "get-together" at *Stellafane*, establishing the affair as an annual pilgrimage to the shrine where the recrudescence of this interesting work took place.

(Continued on page 216)

The bodies of these trucks are made of two thicknesses of bullet-proof steel and the windshields of many of them are made of bullet-proof glass. Each truck contains a steel chest bolted to the floor and each is trailed by a rifle squad in another car.

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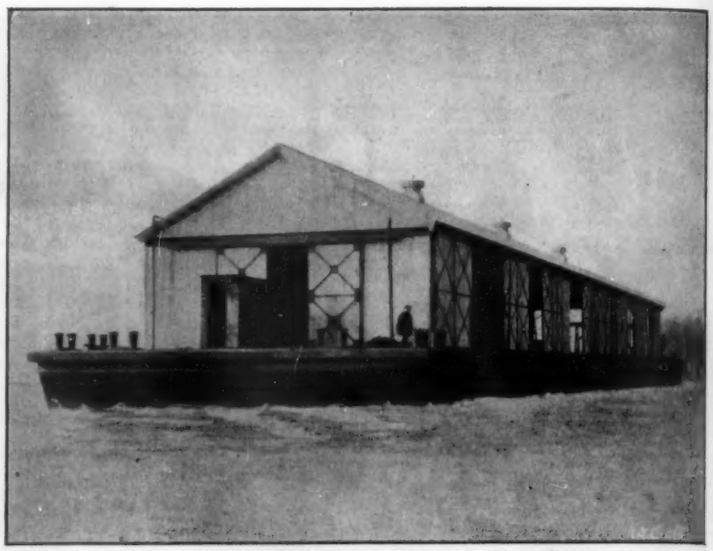


Wharf barge built entirely of steel and iron. The cabin is made of armco iron, which, being almost free from sulphur, is rust-resisting

Floating Wharfs as Barges

WILL the picturesque wooden barges that ply along our many inland waterways be replaced by metal substitutes? Will the oldtime barge captain command a floating wharf? Such a barge with all-metal structure has appeared on the Mississippi River in Louisiana. It is virtually a floating iron house with iron roof, sides, downspouts and gutters. Barges with metal hulls are common, but metal superstructures are not such familiar sights. This unique craft has a cabin of large capacity and apparently great weight. But it is not as heavy as it appears, though more than 20,000 pounds of iron were used in the superstructure alone. The sheets are of light 24 and 26 gage material and are designed to stand hard knocks because of the corrugation; for such sheets have proved to be very strong and durable.

What of the old bugaboo, rust? Such a large surface would ordinarily be a fine field for it. Salt air, water and coal smoke would, as a rule, cause much corrosion. The cabin itself measures 200 feet long by 32 feet wide, while the hull is some 30 feet longer and eight feet wider with a depth of 12 feet. The work of frequently painting such a boat would be very expensive if this was the only preservative used. But this barge cabin is built of a special analysis iron with rust-resisting qualities. While the first cost of such material is slightly higher, its additional life is counted on to justify its use. This iron is also galvanized and it can be painted for further protection if so desired. The large sliding doors are very easy to open or close, and greatly facilitate the handling of freight.

* * *

Smithsonian Anthropologist Finds True American Type in Central Asia

IN far away Tibet, 6,000 miles distant from the nearest point of the American continent, there exist true American Indian types. This conclusion which throws such important light on the question of the origin of the American Indian, is one of the profoundly significant fruits of a remarkable journey of 50,000 miles, covering half the globe and occupying seven months, which Dr. Ales Hrdlicka made under the joint auspices of the Smithsonian Institution and the Buffalo Society of Natural Sciences in 1925, and the first account of which now appears in the Annual Exploration Pamphlet of the Smithsonian Institution.

Dr. Hrdlicka, who is curator of Physical Anthropology in the United States National Museum, and who recently published a description of the new type of white American, undertook his journey to survey what has been and what is being done in the study of ancient man and of the fossil apes in France, India, Ceylon, Java, Australia and South Africa. Such a world survey of the position of physical anthropology is perhaps unique, and it produced results of great significance.

Of the types found in Tibet (and elsewhere in Eastern Asia), Dr. Hrdlicka says that they are so true to that of the American Indian that if they were transplanted into America, nobody could possibly take them for anything but Indian. Men, women and children resemble the American aborigines in behavior, in dress and even in the intonations of their language. The importance of the light his discovery throws on the origin of the native Americans is obvious.

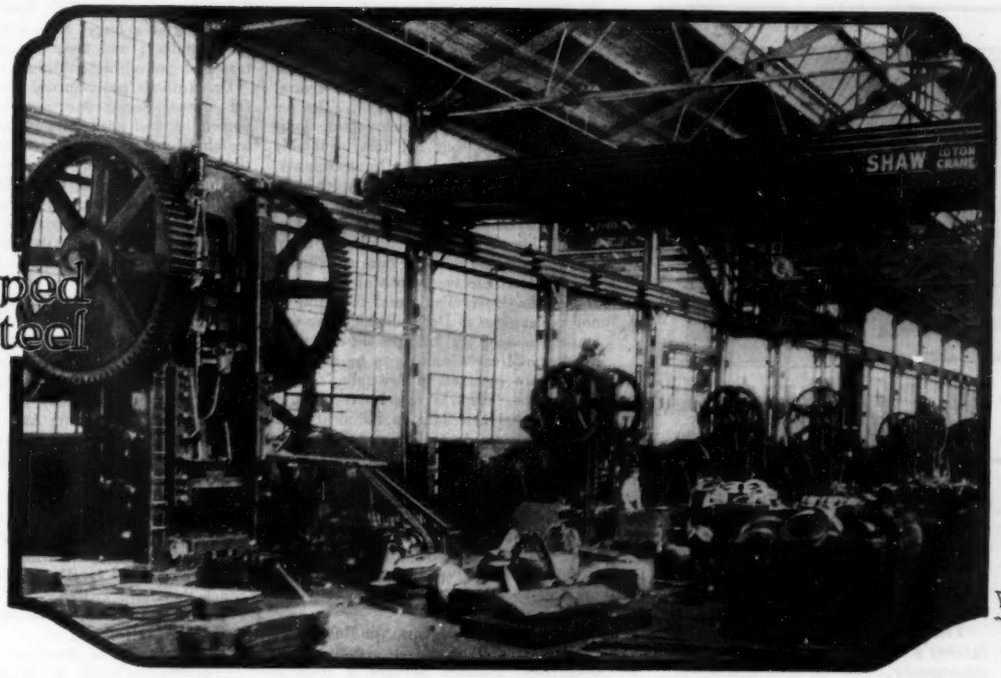
After a brief stop in France, Dr. Hrdlicka early in April last year took ship to India, stopping to examine some Arab types at Port Said and Aden. Of the pure-blood Arab, the anthropologist says that he shows a lively, intelligent white man's physiognomy (thought mostly brown in color), and that the higher class pure Arab is often as light as the Southern European.

At present one of the most interesting problems in anthropology is to explain the presence of the Negrito in the Philippines and Andamans. How did he get to his present homes? His nearest relatives are apparently the Pygmies of Central Africa, but a great unbridged space has until now separated the two. If he extended from Africa he must have left traces of his passing in Arabia and India. Such traces, so far at least as the Indian coast lands are concerned, Dr. Hrdlicka became satisfied do exist. They occur in Parganas, northwest of Calcutta, in at least one area along the eastern coast, here and there among the Dravidians, and in the Malabar Hills. These discoveries bring the Negrito a long way farther to the westward and so much nearer Africa, making his derivation from that continent so much the more probable.

With regard to the bulk of the present population of India, Dr. Hrdlicka believes he can say with confidence that it is mainly composed of three ethnic elements—the "Semitic," the Mediterranean, and in certain parts the "Hamitic" or North African. The "Aryans" show everywhere either the Semitic or the Mediterranean type. Dr. Hrdlicka saw nothing that could be referred to the types of Central or Northern Europe. It would seem therefore that the Aryans came from Persia and Asia Minor rather than from or through what is now European Russia.

Passing through Ceylon, where he reports no definite trace as yet of geologically ancient man, Dr. Hrdlicka proceeded to Java, touching at Sumatra and the Straits Settlements. Of Sumatra, a country not yet perfectly known, he says that "there still prevail in the island, among the whites as

(Continued on page 218)



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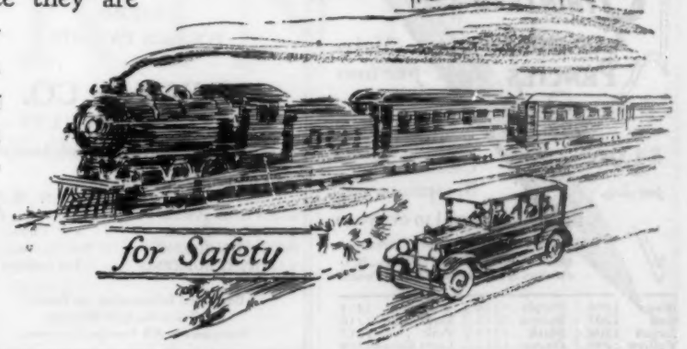

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well as the natives, beliefs in the existence of wild men. There are said to be two varieties. The Orang Pandak (orang—man, pandak—short) is said to live in the almost impenetrable mountain forests of the central and southern parts of the island. The natives describe him as black, short, long-haired, and wild, but not insurmountably shy. The second form is the Orang Sedapak. He is said to live in the unhealthy lowlands of the southeastern part of Sumatra. He is described as having the body of a child of 12, with long red hair on head and body. He is very shy and runs but does not climb."

In the mountainous regions of the upper parts of the Malay Peninsula, according to information given to Dr. Hrdlicka, there still live thousands of negritoid people, and there are many old caves waiting to be explored.

"The data obtained in Australia," writes Dr. Hrdlicka, "throw a very interesting and to some extent new light on the moot questions of both the Australian and Tasmanian aborigines. According to these observations, the Australian aborigines deserve truly to be classed as one of the more fundamental and older races of mankind, and yet it is a race which shows close connections with our own ancestral stock—not with the negroes or Melanesians (except through admixture), but with the old white people of post-glacial times.

"As to the Tasmanians, the indications are that they were but a branch of the Australians, modified perhaps a little in their own country. Both peoples have lived, and the Australians of the northwest live largely to this day, in a paleolithic stage of stone culture. They are still making unpolished stone tools, which in instances resemble the Mousterian implements or later European paleolithic types. But they are also capable of a much higher class of work. Today, about Derby, bottles are used in making beautifully worked spear heads."

From Australia, Dr. Hrdlicka's journey led to South Africa, and disembarking at Durban, Natal, the first task was to see as many as possible of the Zulu, about whose exact blood affinities there was some doubt. From an examination of many individuals, the anthropologist reached the conclusion that the Zulu is unquestionably a true negro, though now and then, as in other negro tribes, showing a trace of Semitic (Arab) type due probably to old admixtures.

The two main objects of the visit to South Africa were the investigation on the spot of the important find of the Rhodesian skull, and of the recent discovery of the skull of a fossil anthropoid ape at Taungs, which had been reported as being possibly a direct link in the line of man's ascent. The Rhodesian skull, found in 1921 at Broken Hill, shows a man so primitive in many of its features that nothing like it has been seen before. Dr. Hrdlicka was able to clear up some of the moot points in connection with this important find, and he collected for study bones of animals from the cave which gave the Rhodesian skull, as well as two additional mineralized human bones belonging to two individuals, all of which were deposited with the earlier relics in the British Museum.

The fossil skull of an anthropoid ape found at Taungs in 1924, belongs, according to Dr. Hrdlicka, to a species of anthropoid ape of about the size of a chimpanzee and evidently related to this form, though there are certain differences, especially in the brain. These differences suggested that this ape may possibly have been somewhat superior to the chimpanzee and nearer to the human. But it is not necessarily a form that stood in the direct line of the human phylum.

South Africa is a land rich in material for the anthropologist, according to Dr. Hrdlicka. "There is," he writes, "the disappearing old native population of Bushmen, Strandloopers, and Hottentots; the newer negro population which amounts already to over 7,000,000 and is steadily increasing; the almost stationary population of 1,500,000 South African whites of Dutch and English derivation, who are blending together and producing a type of their own (as is also happening on a larger scale with the whites in Australia); and there are abundant remains of paleolithic cultures."

Dr. Hrdlicka has returned from his fruitful journey deeply impressed with the opportunities and need for anthropological research offered by all these distant parts of the world, and the openings everywhere for American cooperation. "The story of man's origin, differentiation, spread and struggle for survival," he says, "is evidently greater, far greater, than ordinarily conceived, and a vast amount of work remains for its satisfactory solution."

* * *

Why America Is Prosperous

CONSIDERABLE notice has been attracted in Great Britain, by a report which was recently rendered to British industrialists by two Englishmen, Bertram Austin and Francis Lloyd. These gentlemen have been traveling extensively in the United States, with a view to trying to determine the fundamental causes of the great prosperity of American industry, and whether or not American industries are employing methods which England might profit by studying. "The Secret of High Wages" is the title of the book which they have written.

The findings of these two students of industry are as follows:

"1. Promotion in America is by merit.

2. America sticks to the principle of small profits and quick returns, and wealth is made by fine margins of profit on immense and rapid turnover.

3. Rapid turnover is secured by simplification and cheapening of processes, which necessitates less capital for a given output.

4. America shows endless keenness in devising time-saving and trouble-saving appliances.

5. The American employer is not hostile to high wages.

6. American manufacturers cooperate by exchanging ideas.

7. Americans are vigilant and acute in eliminating waste, and in conserving time, energy, and space.

8. American welfare methods double high wages in their stimulative effect by surrounding the workers with cleanliness and light, and by seeking in every way to increase their convenience and satisfaction.

9. Americans encourage research with magnificent intelligence, scouring the world to obtain the best research brains."

If Britain could teach us her unequalled respect for the law, in exchange for the industrial lessons she is learning from us, both nations would profit.

* * *

Why Clean Rifle Bores? Seal Them.

FIREARMS enthusiasts, as well as those who served in the infantry during the World War, will take interest in a new bore-seal invented by Col. John F. McGill of the United States Marine Corps, for the purpose of hermetically sealing the bores of the United States rifle, commonly called the "Springfield" rifle.

The most sensitive and vulnerable part of our present rifle, insofar as accuracy is concerned, is the muzzle end of the lands and grooves, says Col. McGill, in a report rendered to the War Department. For years riflemen have been cognizant of this fact and have tried by one means or another to protect these parts. To preserve them, however, requires more care and experience than is usually found among those armed with this weapon and too often the piece is ruined because of improper cleaning, or a failure promptly to remove fouling of a corrosive nature from these parts.

In order to seal the barrel many have used a stopper which was forced into the muzzle. This was ruinous because of the moisture and dirt carried into the end of the barrel by the stopper and the resultant pitting and corrosion. This practice is now prohibited.

The whip and friction of a metal cleaning rod when used from the muzzle end will

(Continued on page 220)

quickly destroy the accuracy of the rifle. This practice is also prohibited. These two points are mentioned to show the importance of maintaining the ends of the lands and grooves of the bore intact. The device described below seals the muzzle without coming in contact with the bore, and its use does not necessitate a change in the design of the rifle.

After extensive tests by the Bureau of Mines in 1922, it was found that the principal agent causing the corrosion in rifle barrels after firing was potassium chloride, which is a residue left in the barrel from the primer. As this potassium chloride is the active agent of corrosion, it is necessary that it be entirely removed from the barrel to prevent the rusting and pitting which is the cause of condemning many rifles.

Potassium chloride is a substance that is absolutely insoluble in oil or grease of any kind but is readily soluble in water. Small particles of this chemical lodge in the minute fissures and the tool wounds in the barrel of the rifle, and while a thorough cleaning of the barrel with a cloth saturated in oil will mechanically remove the residue on the surface so that the barrel will appear to be perfectly clean, the particles of the potassium chloride lodged in the manner described remain to corrode and injure the barrel, as they cannot be removed by the cloth and the oil cannot dissolve them.

It is claimed that if the device shown in the accompanying illustrations is promptly placed on the muzzle after firing, care being taken to allow the empty cartridge to remain in the chamber, corrosion from the residue of our present rifle powder, or from atmospheric conditions, cannot occur. The same would apply to rifles in store which had never been fired—corrosion in the bore from the combined action of heat and cold and the various stages of humidity would not be possible.

In other words, the use of the seal would protect the bore more effectually than the most careful cleaning. In fact, a certain amount of injury is sure to occur as a result of cleaning, no matter what care may be exercised, so that a rifle, the bore of which had never been cleaned, would be in better condition provided the seal was properly used, than one firing a like number of rounds, notwithstanding that it may have received the most careful attention. This, of course, has no reference to the metal, or so-called "copper" fouling, which at the present time causes, comparatively speaking, little trouble.

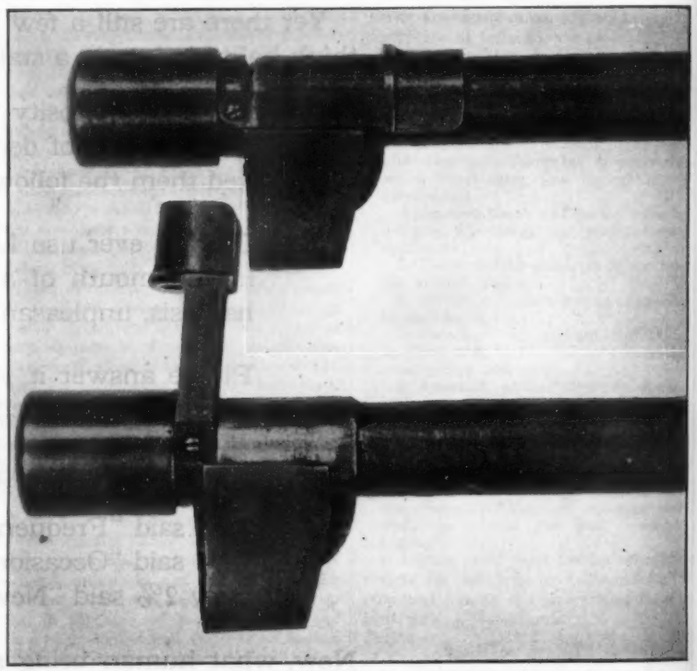
Serious injury to rifle barrels is not infrequent in the tropics because of the deposit of foreign material in the bore by insects. The wasp and ant are the most persistent offenders in this regard. Rifles exposed in racks, or in store, are frequently filled at the muzzle with mud which seems to be particularly injurious in a very short period of time. This deposit is apparently highly corrosive.

Rifles carried in the rain, those exposed in open boats, rifles in racks and in store aboard ship, and those taken ashore by landing parties (where there is no opposition) are subjected, in the absence of a sealed bore, to conditions that can cause serious injury due to corrosion from moisture.

During the World War the destructive effect of phosgene, chlorine, and other gases on the metal parts of the rifles was very marked. It is true that in the majority of cases where rifles were thus exposed they were being fired or held in readiness to fire and the use of the seal would not have been practicable. Nevertheless, much injury was done to rifles not in use and which could have been saved by the use of a seal.

The present bolt of the rifle, when closed with firing pin up or down, will not prevent a certain amount of air from entering the breech. It is therefore best to seal or close the space left between the bolt head and the barrel. This can be accomplished conveniently and economically by closing the bolt on an empty cartridge case.

The subject of corrosion under oil films, with special reference to the cause and prevention of the after-corrosion of firearms, is thoroughly treated in Technical Paper 188 of the United States Bureau of Mines. This may be had only of the Superintendent of Documents, Government Printing Office, Washington, D. C., for five cents (government agencies do not accept postage stamps).



Above: **Colonel McGill's rifle bore seal for the prevention of corrosion, in place of the muzzle of the army rifle. It locks behind the ringlike front sight stud.**
Below: **The bore seal may be removed without tools**

* * *

Fastest Revolving Wheel

WHAT is said to be the fastest revolving wheel in the world, is an important part of the special equipment used by Lieut. John MacReady in his recent attempts to better the world's altitude record. This is the turbine wheel on the supercharger of his airplane. It revolves at a speed almost inconceivable to the human mind, turning 40,000 times a minute; almost 700 times a second.

When it is realized that this speed must be maintained sometimes in a temperature of 81 degrees below zero, the perfection necessary in the mechanism will readily be apparent.

A slight idea of just how fast this is may be gained by comparing it with the speed limit of the average automobile crankshaft. At the highest speed, the crankshaft reaches about 2,000 revolutions per minute or only one-twentieth of the speed of this supercharger turbine wheel.

* * *

Effect of Sea Water on Cannons Sunk for Centuries

FEW of us would believe, on first thought, that cannon balls sunk in the sea for nearly 300 years would become red hot on exposure to the air and then fall to pieces like so much dried mud. Yet the fact is well attested in documents of the British Navy. The data presented below were furnished by Mr. John S. Carpenter, and were originally obtained from the 1882 edition of Trautwine's "Civil Engineer's Handbook."

The *Mary Rose*, which in her day was as proud a vessel as any that sailed the British waters, and which is said to have taken part in the battle with the Spanish Armada, was raised after having lain in Davy Jones' locker for 295 years. When she sank, she was armed with brass cannon and some that were built of wrought iron bars hooped together. The brass cannon were badly honeycombed in spots, that is, locally and not on the entire surface. It was thought that the local corrosion was due to iron having been in contact with the brass at those places. The wrought iron cannon were rusted down about .30 inch deep all over, and flaked off very readily. The cast iron shot or cannon balls, when raised to the surface where the air had access to them, gradually became red hot and then fell in many small pieces like dried mud.

The *Edgar*, a vessel of a later period, gave up some of her cannon and other metal parts after having been sunk for 134 years, as did the *Royal George* after some 65 years. General Pasley, who made the official examinations of the metals recovered, reported that in the great majority of cases the cast iron had become quite soft and that it greatly resembled plumbago. Some of the shot, when exposed to the air, became very hot and exploded into many pieces.

The wrought iron, in this case, was not so much injured, except when in contact with copper or brass gun metal, showing that electrolysis was at work at these places. Neither the copper nor the gun metal was injured, except when iron had been in contact with them. A few pieces of wrought iron were reworked by a blacksmith, who declared that its quality was better than that of modern wrought iron. Some of the cast iron guns were removed in their soft state to the Tower of London, where, after some four years they resumed their probable original hardness.

In the case of a vessel that had been sunk in the fresh waters of the Delaware River for over 40 years, the cast iron cannon raised were found perfectly free from rust.

Unprotected parts of cast iron sluice gates, parts of the sea gates of the Old Caledonian Canal in Scotland, were converted into a soft plumbaginous substance to a depth of three-quarter inch, but where the cast iron parts were coated with tar or pitch, they were entirely uninjured. This softening effect also takes place where the cast iron was embedded in salty earth. Some cast iron water pipes laid near the Liverpool docks, were soft enough to be cut with a knife after 20 years, while the same material of the same pipeline laid on higher ground away from the salt water were as good as new after 50 years.

Observation has shown that the rapidity of this softening action depends much on the quality of the metal, the darker colored types of iron which are high in mechanically combined carbon suffering most, while the lighter colored grades last much longer.

Radio Notes

A Review and Commentary on the Progress in This Branch of Rapid Communication

Conducted by Orrin E. Dunlap, Jr.

Herbert Photos

The highly polished ball that the young man is holding in the above illustration is the latest in radio aerials. The lead-in wire is connected to the surface of the ball, which may be mounted on a pole on the housetop

Doubt If Radio Makes Rain

PAUL PAINLEVE, French Minister of War, recently made a statement that he believed radio waves responsible for the rains and chilly atmosphere that persisted during April, May and June. He called attention to the fact that the introduction of Hertzian waves into a tightly closed room where the air is absolutely transparent causes little drops of water to form on the faces of those present in the room. He explained that the Hertzian fog found in every home had become ionized and electrified, thus forming rain.

When asked for his opinion on this subject James H. Starr, chief of the New York Weather Bureau, said, "I am a skeptic. Perhaps the people in France were complaining of the weather; something had to be blamed so they picked on radio. The more I study weather the more positive I become that we will never be able to control the weather."

When asked to comment upon the Painleve theory, Hugo Gernsback said, "Nothing could be further from the truth. The little amount of energy radiated by broadcasting stations is so infinitesimal that no known instrument can directly measure the amount of energy received three miles from the transmitter. Only by amplifying the microscopic energy, and by employing local "A" and "B" batteries are we enabled to make loudspeakers talk. Heat in a room may cause perspiration but not radio waves.

"Physicians and scientists who use Xrays, which give off a gigantic amount of energy as compared to a broadcasting station find that even with the tremendous amount of ionizing power inherent in the Xrays, no action on the atmosphere is ever noted.

"The plain truth is that the cause of the unseasonable weather lies in the sun," said Mr. Gernsback. "The sun goes through an eleven-year, sun-spot cycle, the minimum of which was in 1922, during which year radio reception was exceptionally good. Since that time the sun-spot cycle has increased and, right now, continuing up to 1928, when the sun-spot cycle is at its maximum, reception will be bad, and incidentally, probably the weather. Radio reception will probably be at its best again in 1933."

Dr. Alfred N. Goldsmith, Chief Broadcast Engineer of the Radio Corporation of America, said that he did not agree with the Painleve theory and did not believe that radio had any effect upon weather conditions.

There is probably as much truth as poetry in the words of the old song:

Whether it's cold or whether it's hot,
We're gonna have weather, whether or not;
The weather we get and the weather we've got,
We're gonna have weather, whether or not.

Music Versus Photographs

WHEN the first radio pictures appeared, someone remarked that they looked just like broadcast music sounded.

"Such a comparison is absurd," said W. H. Priess, President of the Priess Radio Corporation. "The fact is, that on a good receiver today the reproduction of the program is well-nigh perfect. The average ear could detect no difference between the studio program and the same program heard over the radio, providing of course the set and the loudspeaker are of the best obtainable quality.

"Aural radio reproduction is more natural to its original than a good photograph is to its subject. There is simply no basis for comparing it with the accomplishments to date in transmitting pictures by radio. The latter is about in the same state today where all radio was four years ago. We learned to apply the correct electrical principle to the principles of acoustics, and today no one need apologize for radio reception, nor may anyone sneer honestly.

"In the visual problems, they have a start in the knowledge of lenses and camera principles, just as we had in the knowledge of acoustics. Through experiments they will learn how to apply the correct electrical methods, and the problems of the photo-radio engineers will be solved. Until then it is idle to compare the two."

No Radical Changes Expected by Dellinger

THE day of rapid changes in radio receiving sets has passed, and radio is now definitely established as a practical, dependable, permanent utility for every-day use,

according to Dr. J. H. Dellinger, Chief of the Radio Section of the Bureau of Standards.

"Following the period of experimental development, during which the market was flooded with scores of sets of all degrees of receptivity, the industry has now settled down to the production of a relatively few standard high-class sets, expertly designed and substantially built, which may be expected to give as good results five or ten years from now as they do when new," said Dr. Dellinger.

"There is no more reason for waiting to buy a good radio set than there is in waiting to buy a piano. While there doubtless will be occasional refinements in receiving equipment, these are not likely to affect the comparative values of the standard sets of today. Tubes, of course will lose their efficiency after from 1,000 to 2,000 hours of use, but most of them can be reactivated at small cost. The set as a whole, however, will retain its efficiency and value indefinitely."

National Network

SMALLER broadcasting stations in the United States will soon combine to form a chain for country-wide broadcasting, according to Norman Baker, of Muscatine, Iowa, President of the American Broadcasters Association. A hundred or more stations, as the plan is outlined, will be linked together, but not by land wires. The plan is to have each station radiate its own program, and the advertiser using this style of advertising would be announced at the same hour from all stations in the organization. The broadcasts from each station will be entirely different. By this method, country-wide advertising by means of radio will be promoted.

Two Tuning Units

A NEW A-C Dayton receiver, recently placed on the market, incorporates second-stage tuning, which performs as though there were two sets in the cabinet. Where conditions require selective tuning, the first tuning stage is adjusted and then the second stage is brought into phase. This arrangement is said to compensate for differences in antennas, tubes, batteries, interference and other factors which may exist between actual operating conditions in the owner's hands and conditions which existed when the set was tested and balanced at the factory.

Neutrodyne for 1926-27

A NEW model neutrodyne set has been introduced by the Stromberg-Carlson Telephone Manufacturing Company. The general appearance and fundamental design is practically the same as the 1925 model. The changes are in the form of refinements which allow the use of either an outdoor antenna or loop; any semi-power or power tube; any kind of current supply and any kind of power-output equipment. Binding posts are used for loop connections and a switch is provided so that the operator can quickly shift from loop to outdoor antenna. A power-switching relay inserted in the wiring of the "A" and "B" socket power, controls these units automatically as the battery switch on the front panel is turned on or off.

Radio Safeguards Miners

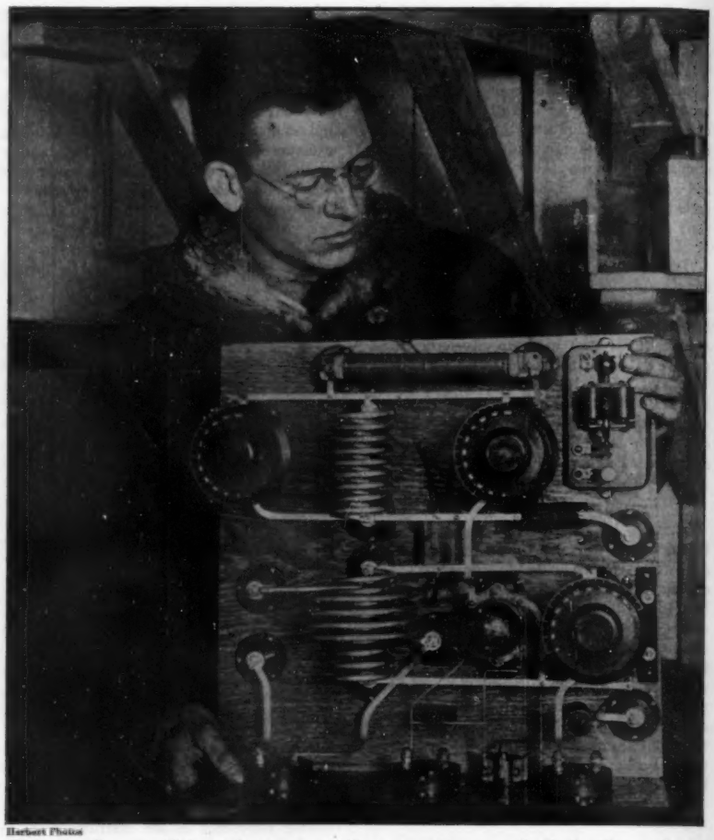
A RADIO warning alarm has been developed to safeguard miners in the Pennsylvania coal fields against explosions of coal dust and the deadly effects of gas accumulation. The use of this device will permit the clearing of the affected areas or the entire mine of the operating personnel, if the ventilating system cannot relieve the dangerous gas collection that is likely to result in explosions and fire.

The instrument is based upon the principle of electrical conductivity of various gases and brings into use the simplest of radio circuits, comprising a variable condenser, a vacuum tube, a sensitive relay and alarm bells. The variable condenser plates are charged with electric energy that is discharged only when the current stored is of sufficient strength to break down the dielectric properties of the medium separating the plates, or when the dielectric itself changes to one of greater conductivity. It is on the latter principle, the change of the dielectric medium, that the mine gas detector works. The air-spaced plate type of variable condenser in the instrument is inserted in a small duct through which air is pumped from various parts of the mine, each gallery having its own separate gas detector unit, located on the surface of the earth as part of the fan and ventilating control equipment.

While the air passing through the condenser is clear of gas and dust, the circuit remains open, but when the air carries coal dust in finely divided particles, the atmosphere between the plates of the charged condenser becomes more conductive, its value as a dielectric depending upon the amount of dust suspended in the air, until the condenser discharges. The frequency of the discharge depends entirely upon the amount of dust in the air. Each discharge of the condenser is accompanied by a closing of the relay circuit that rings the bell. The rate at which the bell rings gives a reliable check on the change of conditions below so that the operator in charge of the

Herbert Photos

The biggest and most popular radio broadcasting station in Japan has the call letters of JOCK. Located at Nagoya, it operates on six kilowatts of power and is heard in California. The above illustration shows the microphone on a special stand for Japanese performers who sit on the floor



Herbert Photos

This simple yet efficient short-wave radio transmitter was built by the students of Marietta College for the American Museum of Natural History Greenland Expedition. Notice the accessibility of all of the parts

control board can regulate the ventilating system to relieve the condition before it becomes a menace, by either drawing out the air or forcing in a fresh draught to dissipate it.

The separation of the condenser plates is dictated by physicists, chemists and mining engineers, who have determined when the percentage of dust and gas assumes dangerous proportions.

Patent Granted Latour

A PATENT with basic claims broadly covering amplification up to the limit of oscillation, with means to prevent disturbing oscillations at all frequencies in multi-stage receivers, together with a common source of space current known as the "B" battery, has been issued by the United States patent office to Professor Marius C. A. Latour of France.

It is contended by the Latour Corporation that practically every type of radio receiver as now manufactured infringes one or more of the eighteen claims of the new patent, which bears the number 1,584,701, and which is assigned to the Latour Corporation of Delaware. The earliest date of priority of invention, as allowed, is October 2, 1916, when the first French application was filed.

The evidence submitted with the application is said to show that Professor Latour was the first to produce multi-stage vacuum tube radio receivers that could be successfully operated without undesirable oscillation or noise. These were the French "L" type SETS.

Reactivating Vacuum Tubes

REDUCED volume may be caused by the loss of active material on the tube filaments. The Technical News Bulletin of the National Bureau of Standards says:

"Electron tubes in receiving sets eventually lose their sensitivity. This sometimes progresses to the point where the receiving set operates very poorly or not at all, even though the tube filaments are not burned out. The user of the set frequently confuses this condition with that due to an exhausted "B" battery.

"If the tubes are of the thoriated tungsten (X-L) filament, (it is estimated that the majority of tubes are of this type), they can usually be rejuvenated by a simple process and made to serve as well as new tubes."

The process of reactivating the tubes is as follows: Disconnect the "B" batteries from the receiver and burn the filaments above normal brilliancy for half an hour. Usually this restores the filaments to full activity.

The best and easiest plan to determine whether or not the tubes are good is to have two or three new tubes on hand and from time to time substitute them for the old tubes. If there is a marked improvement in volume, it is an indication that the older tubes need rejuvenating.

Listening in a London Book Shop

DAVID SARNOFF, Vice-President and General Manager of the Radio Corporation of America, at a dinner of the Radio Club of America, told of his first experience several months ago in talking across the Atlantic via the "talk-bridge."

The call was given the toll operator just as any long distance telephone call is started. It was on a Sunday afternoon and before many minutes had passed, he was talking with Owen D. Young in London.

When Mr. Young returned to New York, he related his story of the accomplishment at the British end of the line. Mr. Young left his home in London to visit an old book shop and when he went out, he told Mrs. Young where she could reach him. While he was gone the phone at his home rang and the long distance operator inquired for Mr. Young. She was given the name of the book shop where he could be reached. The phone tingled in the old shop and the proprietor answered. Then, he said, "It is a call for you, Mr. Young, but I think you had better go over to the Savoy Hotel because this phone is old and rusty. It has

not been used for several months." However, Mr. Young took the receiver and heard the voice of Mr. Sarnoff in New York just as clear as if it was a local call.

Mr. Young explained upon his arrival in the United States that the reason he could not say much over the transatlantic circuit was that he was too much overcome with the wonder of hearing his friend in New York on the phone in the old book shop of London.

A Radio-Piano for WRNY

AN instrument known as a "pianorad," which combines the piano and radio, utilizing the howls from a radio circuit to produce musical notes, has been developed for use at station WRNY.

This radio-piano has a keyboard similar to an ordinary piano, and there is a vacuum tube for each of the keys. When a key is pressed, a radio oscillator circuit is energized, which creates a pure flute-like tone in the loudspeakers connected to receiving sets. The musical notes produced by vacuum tubes in this manner have practically no overtones, and for that reason the music is said to be clearer than that produced by a flute.

The notes are sharp and distinct and are readily distinguished from those of any other musical instrument. Any number of notes can be sounded simultaneously and they can be sustained for any length of time. When a key is struck on an ordinary piano, the sound quickly dies away, but with the pianorad the sound remains as long as the keys are depressed.

The instrument at WRNY has 25 keys and therefore 25 notes. A single stage of audio-frequency amplification is used, but by adding several more stages sufficient volume can be obtained to fill a large auditorium. It is possible to build a pianorad with the standard 88-note keyboard. This would require 88 vacuum tubes.

Why Tubes Are Silvered

RADIO fans often ask why the inside of a vacuum tube is silver colored and mirror-like in appearance. When the tube is completely assembled, the gases and air are pumped out. Then magnesium wrapped in a piece of thin nickel and held in a small side tube is heated by a high-frequency induction coil until the magnesium vaporizes and condenses in the bulb, giving it the appearance of a mirror. The magnesium reacts with the last traces of the more troublesome gases left in the tube after the pumping operation and cleans them up, producing a still higher vacuum. The tube is then sealed and based by automatic machinery.

How Tube Filaments Are Developed

THE filament structure of modern vacuum tubes was recently explained over station WGY by F. C. Kelley, of the General Electric Research Laboratory.

"The filament is made of tungsten, one of our rare metals," said Mr. Kelley. "It is more than 19 times as heavy as an equal volume of water and melts at a point higher than any other metal. The tungsten is obtained in powder form and is mixed with small percentages of thorium oxide and carbon. It is then pressed under hydraulic pressure into bar form. If handled at this stage the bar will break, so it is supported on a solid slab of tungsten and pushed into a hydrogen furnace, where it is sintered at a white heat. It is then refired at a temperature just below the melting point and in an atmosphere of hydrogen by passing a very heavy current through the bar. The bar sinters or shrinks both in length and cross-section and the carbon reduces the thorium oxide to pure thorium metal.

"The density of the bar is then about the same as pure tungsten which has been melted, and can be hammered hot into round rods and then into small wire. The wire, after reaching a certain diameter, is drawn down cold through diamond dies to filament size and this gives the final filament material."

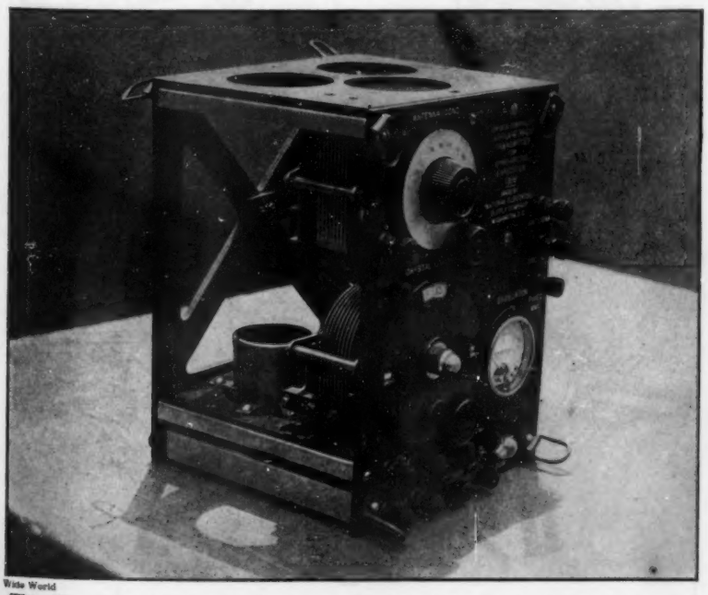
Tungsten and Nickel In Grid and Plate

THE grid of a vacuum tube is made of tungsten wire wound around two nickel supports in the form of a flattened spiral. Each point of contact between the spiral grid and the support wires is welded.

The plate consists of a flattened cylinder of thin sheet nickel welded to nickel supports.

Detector Uses Double Plate

AN eight-tube tuned radio frequency circuit, designed by Fred A. Jewell of North Carolina, has been introduced by the Jewell Radio Company. The receiver uses a vacuum tube detector provided with two plates instead of one plate as is the usual practice. The inventor explained that the double plate allows push-pull amplification in the detector and gives increased amplification with minimum distortion. Two dials control the tuning.



Wide World

This illustration shows the radio transmitter that Commander Byrd took to the north pole with him on his recent memorable flight. The set uses an oscillating crystal circuit for control of the transmitted wave

Learning to Use Our Wings

Aircraft are being put to use in peace as well as in war. This department will keep our readers informed of the latest facts about airships and airplanes

Conducted by Alexander Klemin

In charge, Daniel Guggenheim School of Aeronautics, New York University

An Interesting Engine

IN the modern aircraft engine it is essential to obtain high power for a given weight. This is largely obtainable by a high piston speed. But high piston speed in the ordinary internal combustion engine also means high speed of revolution of the crankshaft and a high propeller speed. This is an excellent condition for a very speedy, single-seater fighter. But for a comparatively slow commercial plane, high propeller speed means inefficiency. The forward speed of the plane bears too low a ratio to the peripheral speed of the propeller. To meet this difficulty, propellers are very often geared down, with the disadvantages of weight and complication.

In a new engine, of almost revolutionary conception, high piston speed is combined with low propeller speed without the intervention of any gears, by a most ingenious mechanism.

This engine is the Fairchild Caminez, designed by Harold Caminez, formerly an expert with the Engineering Division of the Army Air Service. The engine is illustrated in these columns.

Instead of the conventional drive from the piston, through a connecting rod to the crankshaft, the reciprocating motion of the pistons is converted into rotary motion of the propeller shaft by means of rollers operating on a double lobed cam, somewhat like a figure of eight, fixed rigidly on the shaft. The mechanism is such that each piston completes four strokes for every revolution of the shaft—while in the ordinary engine, the piston completes only two strokes for every such revolution. Therefore for a given piston speed the crankshaft revolves just half as fast as in the ordinary engine.

Adjacent pistons are connected by a system of links, the contour of the drive cam being so designed that these links maintain the piston rollers in continual contact with the cam. As a result the cam shows not the slightest wear under prolonged running.

Another important difference of the Caminez engine from the ordinary engine is that the motion of the pistons in opposite cylinders is identical with respect to the engine axis, so that the piston inertia forces balance one another exactly.

Further, since the pistons make four strokes per revolution there is no necessity for valve gearing and intermediate shafting; single lobed intake and exhaust cams are mounted directly on the main engine shaft which operates all the valves in the engine. This makes for tremendous simplification.

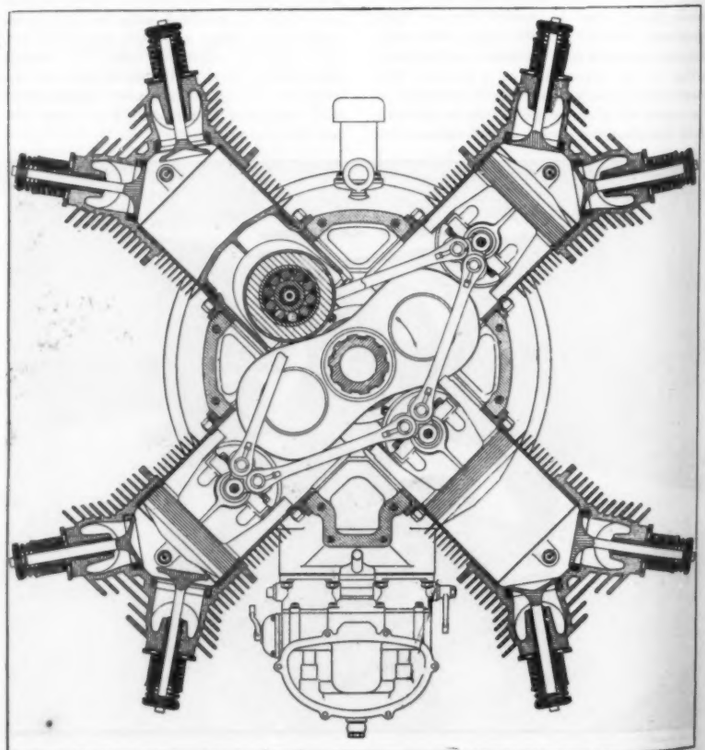
The direct action of the piston rollers on the figure of eight cam brings the cylinders closer together, and therefore produces compactness, lightness and less head resistance.

The beautifully made and ingenious mechanism has undergone exhaustive tests both on the block and in the air, having been mounted in the well-known Avro biplane. In spite of its robust construction the 150 horsepower engine only weighs 360 pounds, and its projected frontal area is only 3.9 square feet.

We believe that the keynote to successful commercial aviation lies in simpler and more reliable power plants. There is no doubt that the Caminez Fairchild engine marks a decided step in this direction.

The Kite Balloon

THE advent of the power driven airship and airplane has greatly decreased the interest in ballooning, once a most popular sport. Kite balloons, a modification of the spherical balloon, attract even less attention. Yet the kite balloon serves many useful purposes, and its design teems with intricate aeronautical problems.



A line drawing showing a longitudinal section of the engine which shows the fundamental conception of the engine even more clearly than the photograph

Wide World

Sherman M. Fairchild and Harold Caminez examining the "Cam" engine dismounted from the plane and partially disassembled. The photograph shows clearly the figure of eight cam on which the piston rollers operate and the links which keep adjacent pistons in constant contact with the cam

Kite balloons were successfully used during the war for spotting submarines; observers in telephonic communication with the patrol ship could give notice immediately of the detection of the wake or "shadow" of a submarine below the surface. On the western front, kite balloons provided effective, although very hazardous observation posts. In commercial aviation it is possible that kite balloons may be employed at large airports for providing meteorological data, for wireless work and perhaps for the marking of airways.

An efficient kite balloon should be able to rise rapidly to a good altitude; offer a minimum resistance to the wind so as not to impose undue strains on the holding down cables and provide a fair degree of stability. Nothing is so conducive to violent seasickness and loss of observational power as a violently oscillating captive balloon.

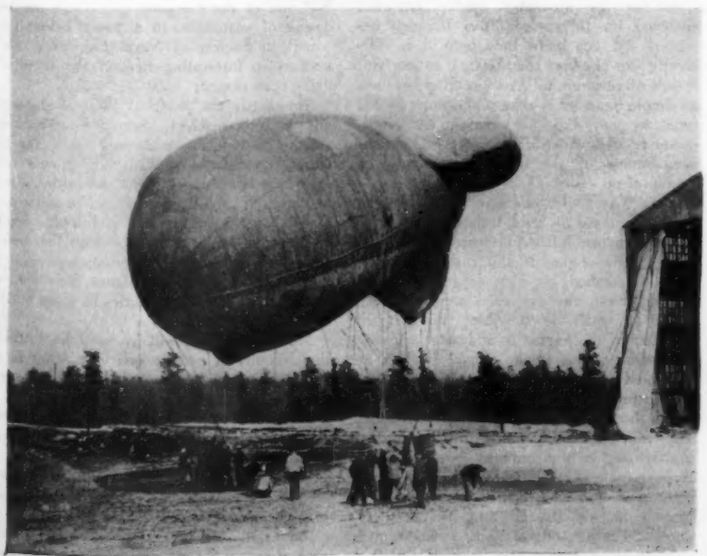
A kite balloon is used at the Navy's airship station at Lakehurst for yet another purpose—the provision of an aerial platform from which aviators may practice parachute jumping with less hazard than from a rapidly moving airplane.

The envelope of such a balloon containing the gas must be of large proportions, if it is to raise the occupants of the basket and the heavy kite cable to a fair altitude. It must be streamlined, to minimize resistance to the wind. No fabric in the world could stand the concentrated pull of basket and occupants. Therefore, the kite cable at the bow of the balloon, and the basket suspension towards its center transmit their subdivided pull to a large number of running "bridles," which in turn are attached to a strong rigging band running the whole length of the envelope, with the gas lift at each section of the envelope taking a proper amount of pull.

There must be provision in every kite balloon for vertical equilibrium and for the maintenance of the shape of the envelope. This is taken care of by an internal air chamber, situated more or less at the stern of the kite balloon, and entitled the ballonet. Imagine the balloon fully inflated at a height of say 6,000 feet. In descent the gas would contract and the balloon lose its shape. It is then that the ballonet comes into play. Drawing air through the scoop in the bow, it takes up sufficient air as the hydrogen or helium gas contracts, to preserve the exterior form.

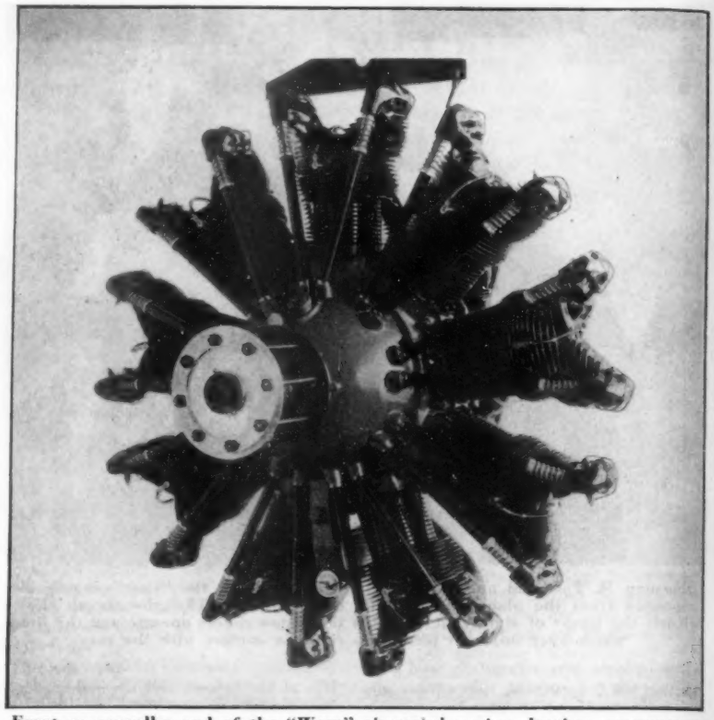
To further maintain stability, either longitudinal or lateral, the kite balloon must have tail surfaces. The kite balloon has three tail surfaces; the vertical one and two others at sixty degrees to the vertical. When the gas has inflated the envelope it also inflates the tail surfaces, which are handier, lighter and more practical in every way than any solid fins that might be applied to the envelope.

Perhaps these brief lines will serve to



Wide World

The kite balloon which may be used for observation purposes



Front or propeller end of the "Wasp" air-cooled engine showing compactness and "cleanness" of the design, with the valve gear enclosed to offer minimum air resistance and thus increase efficiency

give the reader an incentive to further consideration of these apparently simple, yet in reality complex contrivances.

A New Air-Cooled Engine

SOME few months back we discussed the respective merits of air-cooled and water-cooled engines. The controversy seems to be rapidly closing in favor of the air-cooled type. The new "Wasp" engine, built by the Pratt and Whitney Aircraft Company, is a case in point.

The famous Liberty motor which is rated at 400 horsepower, weighs 837 pounds. The D-12 water-cooled, twelve-cylinder engine delivers 425 horsepower at 2,100 revolutions, weighs only 720 pounds and is a marvel of engineering skill. The "Wasp" also delivers 425 horsepower at 1,900 revolutions per minute, yet only weighs 650 pounds. When we consider that the water-cooled type needs a radiator, water in cylinder jackets and radiator, and a system of pumps and piping, the whole weighing between 150 and 200 pounds, it can be seen that the advantage in point of weight for the air-cooled type becomes very important.

So far the air-cooled engine has not achieved its full possibilities because designers did not know how to cool it sufficiently for higher compression ratios and speeds of revolution. As its cooling becomes as simple a matter as that of the water-cooled type, we may expect its weight per horsepower to go down still further. The inherent compactness of the star-shaped, air-cooled engine of necessity makes for light weight.

The "Wasp" also offers interesting points in the decrease of head resistance, an item just as important as lightness. The resistance of the engine to the rush of air has been diminished by four distinct lines of attack. First, the projected area has been made as small as possible; the over-all diameter of the engine is at least six inches smaller than that of the Bristol Jupiter, an air-cooled engine of the same power. Next all the valve gear has been enclosed, including push rods, valve springs and rocker arms. The resistance of parts projecting beyond the cowling is thus reduced to a minimum. By careful design of the cooling fins, the amount of engine which it is necessary to project beyond the cowling has been reduced. Further, all of the accessories, such as magnetoes, carburetors, and oil and fuel pumps have been placed at the rear; as a result, the airplane designer is able to make the front cowling of streamline form.

Our photographs illustrate some of these characteristics. One shows the front or propeller end, with the valve gear enclosed, while another gives a side view of the engine with the accessories in place at the rear. We also show a photograph of the Navy shipboard plane, the *Apache*. The cowling covers almost the entire engine and is nearly prefect in its streamline.

The use of the air-cooled engine has enabled both speed and climb for shipboard planes to be improved and the overall size of the plane to be diminished, which is a very important consideration from the point of view of stowing below decks.

Incidentally it is worthy of note that the carburetors on the "Wasp" are provided with a system of rotary induction which distributes the gas uniformly to all cylinders. There is no doubt that such practice is likely to be used extensinvely on aircraft engines of the future.

The Future of the Flying Boat

COMMANDER H. C. RICHARDSON, one of the foremost authorities on the design of seaplanes, in a paper before the American Society of Naval Engineers summarizes in interesting fashion the trend of flying-boat design.

Apparently the practical limit of size has not yet been reached. Seaplanes of a gross weight of 30,000 pounds and more appear entirely practicable. With land planes, increase in size entails many difficulties, both in handling on the ground and in the enormous hangars which are required. With seaplanes, increase in size has the overwhelming advantage of producing greater seaworthiness; large seaplanes have shown remarkable handling qualities in quite rough seas.

Multiple engines will be used because of the difficulty of getting sufficient power in a single unit and because of the added security of the multiple power plant.

Air-cooled engines will gradually displace the water-cooled engine with its many troubles.

The fuel will gradually change from gasoline to heavy oil, reducing the cost and eliminating fire hazard.

The hull will no longer be the water-soaked wooden structure now familiar, but will be framed and plated with metal, either

alloy steel or duralumin. It will be well subdivided and probably have a double bottom.

Some form of servo-motors will be employed on larger seaplanes to operate the controls. In a large ship and on long flights the muscular demands on the pilot are already excessive.

In seagoing planes, the monoplane will probably dominate. The wing is far higher from the water than the lower wing of a biplane, and is therefore less subject to damage in heavy seas.

Just as an ocean liner carries a number of auxiliary engines in addition to its main power plant, so the seaplane will ultimately be equipped with small auxiliaries for the handling of anchors and lines, drainage, lighting, signaling, and possibly an auxiliary engine in conjunction with a marine propeller to provide for propulsion when afloat.

On passenger planes, life rafts will be provided.

Landing speeds will be under 50 miles per hour, and high speeds may reach 130 miles per hour for even the very largest craft.

Apparently the day is rapidly coming when the seaplane will be large enough and well enough equipped to be entirely serviceable for commercial operation.

Steam Power in Aircraft?

THE remarkable reliability of the steam-power plant in ocean-going vessels, causes engineers and inventors to revert again and again to the question of steam power in aircraft. Another reason why steam power for the airplane is of interest is the fact that while the internal combustion engine loses power rapidly with increasing altitude, the steam-power plant increases in horsepower and efficiency the lower the pressure of the exhaust, and has therefore everything to gain in altitude flight. Experimentation and analysis do not seem, however, to give much hope of steam utilization in flying. Commander E. E. Wilson in a Technical Note of the National Advisory Committee for Aeronautics, takes an unfavorable view after serious study.

The modern airplane engine challenges the use of steam with the following figures: Its weight is less than three pounds per horsepower and it consumes only one-half pound of fuel per horsepower-hour. Its reliability is constantly increasing, failures remaining frequent only in the "plumbing,"—water, gasoline and oil lines and systems, where reduction of weight has been carried beyond the point where reliability can be maintained. This plumbing is being rapidly improved, and by the use of air-cooled engines, one very important phase of the plumbing disappears entirely.

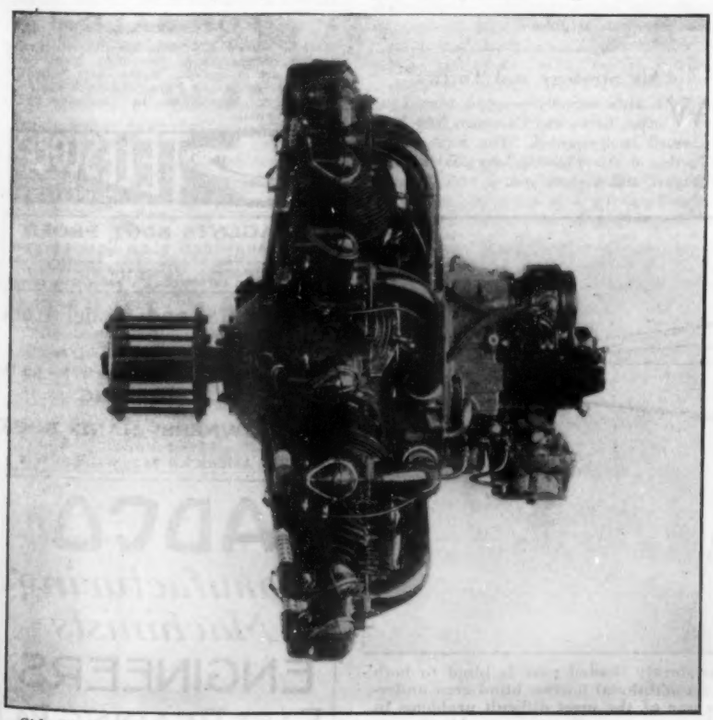
Now examining the steam-power plant, we see that it must comprise a boiler; the engine; auxiliaries; and a condenser because no aircraft could possibly carry sufficient water on board to operate a non-condensing engine.

To challenge the internal combustion engine, the steam engine must be a high-speed turbine, with considerable speed reduction to the propeller, and since the efficiency of the ordinary steam turbine is such that the fuel consumption is one pound per horsepower-hour, instead of the half-pound figure in the present aircraft engine, the steam turbine must work at pressures far exceeding those hitherto employed. Something of the order of 1,000 pounds per square-inch pressure would have to be employed to make up for the inherent inefficiency of the steam engine cycle as compared with the internal combustion engine cycle. Commander Wilson concludes that only in very large units and with such pressure could a steam turbine be developed weighing one pound per horsepower and having a fuel efficiency equal to that of the internal combustion engine.

But with this enormous pressure of 1,000 pounds per square inch, is it not likely that the greater reliability of steam operation will vanish? Yet in a crash, the possibilities of damage with steam at this enormous pressure are terrible!

On the other hand, with the steam turbine, it would be possible to use a heavy fuel, lessening operating cost and to some extent the fire hazard.

The turbine itself is far from completing the steam-power plant. We must have a boiler, or steam generator. From weight considerations the only possible type of boiler is the flash boiler, consisting essentially of a system of tubing into one end of which feed water is forced, while from the other end steam issues. No storage space for either surplus water or steam can be provided, and hence more or less complicated devices must be introduced to maintain the proportions of fuel and water supply at desirable values under sudden fluctuations of load. Fire brick or other refractory lining for the combustion chamber must disappear because of prohibitive weight. The combus-



Side view of the "Wasp" engine. All the accessories are placed at the rear

The "Apache," a navy shipboard plane equipped with the "Wasp" engine. Little of the engine projects beyond the cowling, and because the various accessories are at the rear of the engine, the airplane designer has been able to blend the lines of the cowling smoothly into its fuselage. Side doors in the cowling give ready access to magnetos, carburetor, et cetera

tion chamber must be enclosed in walls of steel tubing, through which the steam generated in the heating coils passes and becomes superheated. In an actual steam generator constructed, the boiler consisted of 16 parallel streams of half-inch flat tubing in which the steam was completely evaporated, and then passed through seven larger tubes for superheating. Fans, pumps and other auxiliaries had to be added to the generator proper.

Commander Wilson concludes that a suitable generator could be produced weighing two pounds per horsepower complete, and having adequate thermal efficiency.

The steam plant then apparently would meet the requirement that it should weigh not more than about three pounds per horsepower.

But there remains the question of condensation.

The internal combustion engine needs far less cooling than the steam engine, because in steam work, the vapor must be re-converted to water and the latent heat of steam is enormous. Exact computations show that with a turbine which must function at low pressure to be efficient, the steam plant would require 11½ times as much radiator surface as the internal combustion engine of the same power.

The weight of the steam-plant radiator therefore becomes prohibitive. And further, the horsepower required to pull the enormous radiators through the air would equal the horsepower required for the propulsion of the entire plane!

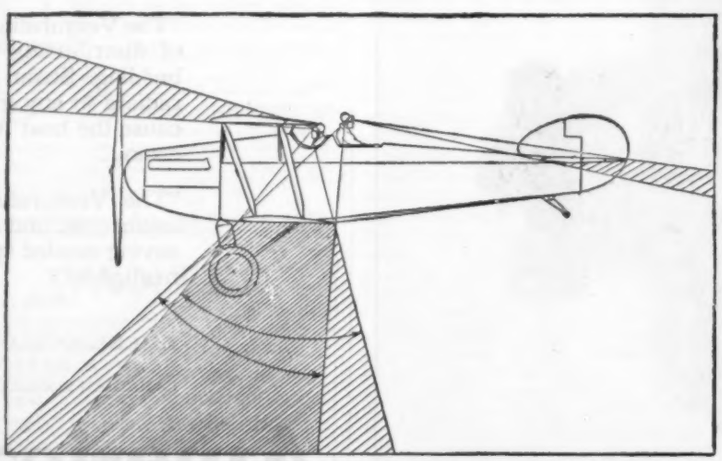
Is it possible to eliminate this process of condensation to some extent? Perhaps by the use of a mercury boiler, in which the heat of condensation of the steam is transferred to the mercury which in turn is utilized in a turbine, so that only the condensation of the mercury remains to be dealt with. In the mercury-steam plant, the high boiling point of the mercury also reduces the pressures required, and because of the high molecular weight of the mercury, smaller turbine dimensions become possible.

Commander Wilson thinks it possible that a steam-mercury plant might be developed for about five pounds per horsepower, in which much of the cooling surface required would be reduced to practical proportions and an efficiency equal to that of the internal combustion engine attained.

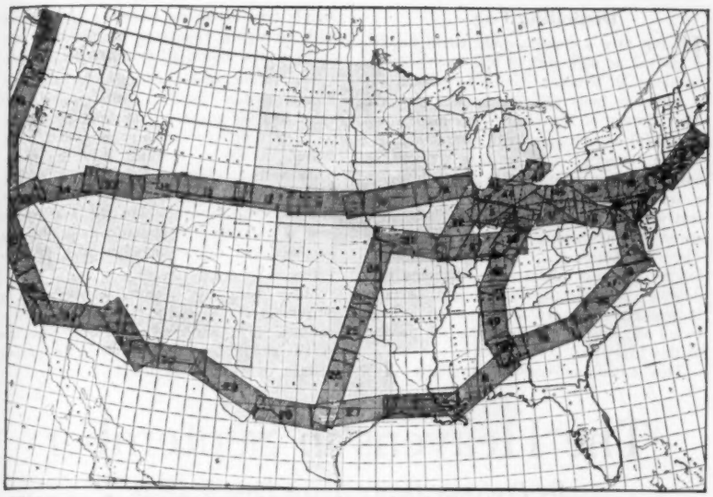
But the very reason why we are seeking to use steam is simplicity and reliability. The inventor or engineer who would seek to use a mercury-steam plant aboard aircraft might run into even greater complications than harass us at present.

Air Strategy and Tactics

WE have recently received from Longmans, Green and Company, New York, a small book entitled, "The Strategy and Tactics of Air Fighting," by Major Oliver Stewart, and we have read it with the great-



Blind areas in a two-seater fighter. The darkly shaded part is blind to both pilot and observer. The fuselage causes an additional narrow blind area underneath. The elimination of blind areas is one of the most difficult problems in the design of military airplanes. Also, in peace as well as in war, blind spots are always a potential source of danger



Flying maps cover much of the area shown by the bands of diagonal hatching. In the shaded states, the principal air routes are being sign-posted

est interest. Aerial combat is often thought to be a matter of reckless bravery and dash. Bravery and dash the air fighter must have, but he must also be imbued with principles of strategy and tactics, and think out his plan of combat more carefully even than the soldier on land.

Supposing New York City were in danger from a night attack by air, methods of detection would become of paramount importance. The French system for such work is particularly interesting. Many special lamps which threw very wide beams (not searchlights) are directed upwards from the ground. A friendly machine flies high over the lamps and when the enemy machine passes between the friendly machine and the lamps, the enemy machine shows, to the watchful aviator, as a shadow crossing a lake of light.

Even in broad daylight it is harder to keep track of a plane than would be imagined. Major Stewart gives a graphic example. In the war it was common experience for a patrol leader to lead a patrol containing a novice into battle with an enemy formation. Upon the breaking off of the combat, the novice would be missing. Back at the airdrome, he would be found to have landed safely and to have seen not a single enemy airplane! The novice had lost his squadron completely.

In most airplanes there is some region in which, owing to the position of the wings or tail surfaces, gun fire cannot be directed. Every designer of military aircraft has struggled to eliminate these blind spots, since the attacker gains an enormous advantage by approaching in the shelter of such a spot. The appended diagram shows this condition of affairs clearly for a very well designed two-seater.

Air fighting involves the most curious maneuvers and their study is one of the most intricate problems in dynamics. The book describes these maneuvers in a particularly clear and interesting manner.

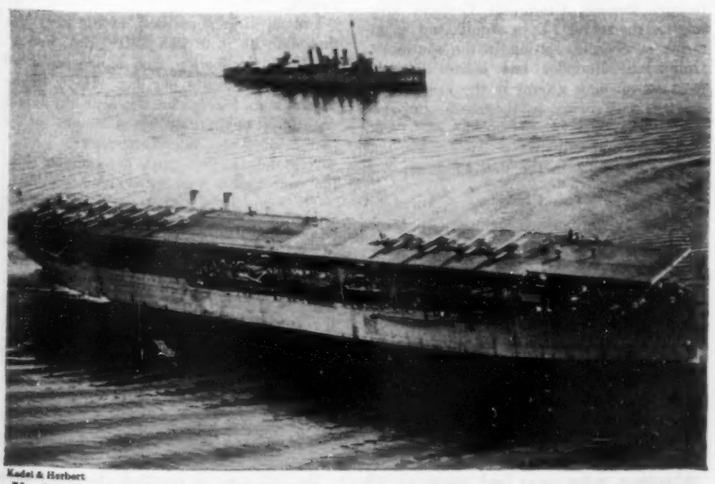
We wish we had space to deal with more of the fascinating problems and ideas brought up by the author.

Mapping and Signs

JUST as important to the operation of commercial airlines as weather information signs, is the provision of maps and air signs. Intensive work is being carried on to provide such maps and signs for at least those portions of the country where flying is being carried on regularly and intensively. In the accompanying chart, which is reproduced by courtesy of the *National Aeronautic Association Review*, is shown the territory already covered by 48 maps prepared by the Engineer Corps of the Army and the Air Service. These charts show the characteristics of the territory, shape of the cities, elevations of the ground by a series of colors, railroads, rivers, et cetera. The maps also show "route lines," indicating the preferable flying route between cities with regard to the availability of emergency fields.

Air signs are also rapidly covering the country, particularly in the west. Town and city names in letters eight or ten feet high have been painted on black backgrounds on tanks and buildings. Landing fields are being marked by 100-foot circles of crushed stone or cement. The Standard Oil companies are particularly active in this route marking.

While Europe is relying on ineffectual subsidies, in the United States a more effective aid to commercial air transport is being planned. It embraces a system of aids to navigation in the form of maps and signs.



Kadel & Herbert

Uncle Sam's giant aircraft carrier, the *U. S. S. Langley*, headed out to join the fleet, with fourteen airplanes on her "take off" deck

Dispelling Fog

IF fog over a landing field could be dispelled at will, one of the most difficult problems in aviation would be solved. It is therefore most pleasing to hear that the Navy Bureau of Aeronautics has made some successful experiments in this direction.

Navy experts estimate that 277,000,000 cubic feet per minute of fog drift through a vertical plane having a radius of 1,000 feet with its center at the ground, when the speed of the drift is two miles per hour. There is therefore an immense amount of fog to deal with under not uncommon conditions. Yet electrically charged curtains in one type of navy apparatus have been found capable of precipitating 95 percent of this fog.

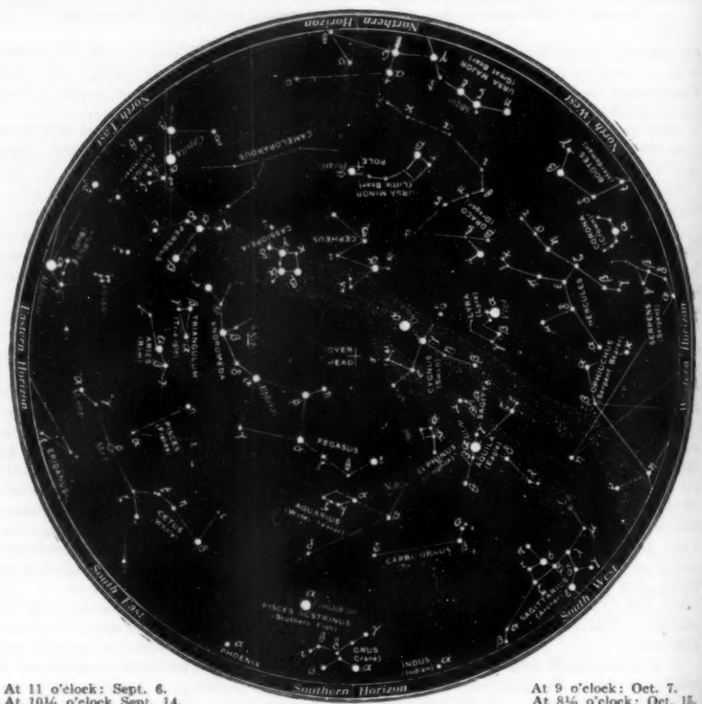
This apparatus consists primarily of a simple type of corona screen, a transformer with rectifying apparatus, an airplane propeller and a motor, all mounted on a truck.

The corona screen charges the air electrically, and is capable of charging 700,000 cubic feet per minute. The propeller, driven by a 400-horsepower motor mounted on a swivel, discharges this air into the imaginary vertical curtain of 1,000 feet radius. The oncoming fog meets this charged air and is itself charged. As the fog passes over a projected electrostatic field, the fog particles are driven together and precipitated.

Many more experiments are necessary to determine the distance to which the electrostatic field can be projected; how the corona should be set up, what is the proper voltage to use and so forth.

The Heavens in September

By Professor Henry Norris Russell, Ph.D.



At 11 o'clock: Sept. 6.
At 10½ o'clock Sept. 14.
At 10 o'clock: Sept. 21.
At 9½ o'clock: Sept. 30.
At 9 o'clock: Oct. 7.
At 8½ o'clock: Oct. 15.
At 8 o'clock: Oct. 22.

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on September 6, etc.

NIGHT SKY: SEPTEMBER AND OCTOBER

The Heavens

ON our map of the heavens this month we find the Milky Way in a great circle overhead, from Auriga in the northeast, through Perseus, Cassiopeia, Cepheus, Cygnus (at the zenith), Lyra, Aquila and Sagittarius to Scorpio, setting in the southwest. Ophiuchus, Hercules and Boötes are the most conspicuous groups in the west, Draco and the two Bears in the north, Pegasus, Andromeda and Aries in the east and northeast, and Aquarius, Capricornus and Pisces Austrinus in the dull southeast.

The Planets

Mercury is a morning star until the nineteenth, and an evening star after that date, but he is well visible only at the beginning of the month, when he rises about 4 A.M.

Venus is still conspicuous as a morning star, rising about 20 minutes before Mercury on the 1st, but remaining in sight after the latter has passed to the other side of the sun.

Mars is growing more conspicuous as he approaches opposition. In the middle of the month he rises at 9 P.M., and looks almost as bright as Sirius. He is only about 50 million miles away and telescopic observers will be actively engaged.

Jupiter is now best visible in the evening, coming to the meridian at about 10 P.M., while Saturn is well down in the west at sunset, and sets between nine and ten o'clock.

Uranus is in opposition on the 21st. On that date he is in 23h 52.0^m R.A. and 1° 44′ south declination, and is moving 8.″8 west and 57″ south per day. He is in the constellation Pisces, but not near any bright stars that might help to pick him up, so that a good star map is required.

Neptune is just past conjunction with the sun, and is practically unobservable.

The moon is new at 1 A.M. on September 7th, in her first quarter at 11 P.M. on the 14th, full at 3 P.M. on the 21st, and in her last quarter at 1 P.M. on the 28th. She is nearest the earth on the 21st (when we will have very high tides, but *not* on account of the equinox), and farthest off on the 7th. During the present month she is in conjunction with Venus on the morning of the 5th, Neptune later the same day, and Mercury that evening, with Saturn on the 12th, Jupiter on the 18th, Uranus on the 21st, and Mars on the 25th, none of the observable approaches being close.

At 2:27 P.M. on the 23rd, the sun crosses the celestial equator, and "autumn begins."

Another Answer to the Crossing Problem

The elimination of accidents at railroad crossings is still an unsolved problem. Among the many suggestions received, we believe that of Mr. Sambert has considerable appeal as it involves little expense and is practically foolproof, not depending on any mechanical contrivance:

Editor, Scientific American:

With reference to your May edition, page 341, letter W. W. Ward, on the subject of "Prevention of Accidents at Railroad Crossings."

I wish to submit to your attention a solution which I believe to be superior to any similar solution, as yet offered and published.

As a matter of fact, I believe that it is the only logical solution under ordinary conditions, since it is far more simple, economical, practical and foolproof than any other solution known to the writer.

However, please, judge for yourself.

I propose that a piece of the road, about 100 feet long or more, on each side of the railroad track, shall be left in a more or less primitive or indifferent condition, without, of course, allowing such a condition to become dangerous to any degree.

The bumps and depressions in these short stretches of the roads shall be most pronounced at a distance of about 20 or 30 feet from the railroad tracks. In this manner, the gradual increase of bumps and depressions in a road would not only warn a driver of the proximity of railroad tracks, but it would force him to slow down, as he always should, or else it would make him pay the immediate penalty of a severe shake-up of his and other peoples' anatomy plus car, something very few people seem to care for.

This method of discouraging and preventing speeding across railroad tracks is absolutely foolproof, because its efficiency does not depend upon weather conditions, et cetera, nor upon the reliability of some specific mechanical device.

The cost of installation is less than nothing, since its installation is coincident to the actual saving of public funds (which become available for better purposes). Why spend money to build and to maintain good roads right up to the railroad tracks? Why tempt the speeder to do that very thing which we are all trying to keep him from doing? It seems illogical to first spend money for one thing and then to spend more money to eliminate certain unwanted consequences of the first expenditure.

I also believe that the average foreman of a road-building or repair gang would be glad to lend his cooperation, and that these men are quite competent to understand what kind of a bumpy piece of a road would be wanted for this particular purpose, if the mere omitting of repair work should fail to accomplish it. Experiments in this direction could be made very easily under various conditions and without any extra expense.

May I not suggest that the Scientific American (which has done so much valuable missionary work for the promotion of safety and for the prevention of traffic accidents) communicate with a number of progressively managed insurance companies, railroads, and automobile owners' associations, for the purpose of securing their individual opinions on the subject discussed in this letter?

Yours Very truly,
J. Sambert.

A Tree that Swallowed a Tree

Last month we had a note about an egg within an egg. Now we have a tree within a tree. This fir tree that swallowed another was brought into the sawmill at Springfield, Oregon, and our contributor, Charles Oluf Olsen, describes it thus:

Not long ago a butt fir log nearly four feet in diameter was brought into the sawmill of the Booth-Kelly Lumber Company, Springfield, Oregon. During the process of sawing it was discovered that here was a tree that had evidently swallowed another one. Counting the growth rings, the larger outside tree

The tree within a tree as it was found after the sawmill had removed the outside layer of the larger of the two. The inner one had stopped growing

In this view, the saw has cut to the inner tree and the remaining parts of the outer one have been pulled apart to show the complete tree within

was estimated to be 215 years old and the little inner one, 15 inches in diameter, 110 years old, at the time of cutting.

When and how the swallowing process took place is a matter of conjecture, but no doubt the two trees originally stood closely side by side, and in the course of growing came to press against one another to such an extent that they gradually became one. When the two trees first touched, both were young, the larger not much over 50 years old and the smaller around 35. The larger and more powerful slowly enfolded the smaller until it died from want of sun and air, after a struggle of many years' duration. Then the larger tree, evidently satisfied with its victory, kept on growing until the woodmen's axes laid it low about 75 years later.

The photographs show only the center section of the log, the outside slabs having been cut off before the interesting phenomenon was observed.

One on Us

Who says a Scotchman has no sense of humor? The pleasant chuckle we indulged in upon reading the letter below took most of the sting out of the fact that we had made a blunder.

Editor, Scientific American,
Sir:

On page 64 of the July number of the Scientific American there appears a photograph of a gentleman explaining certain features of an aeroplane to a number of schoolboys, and the explanatory paragraph under the photograph commences as follows: "The master of Sempill," "an English school, recently . . . . ."

Well, Sir, you certainly did drop a brick there. "The Master of Sempill" is a Scottish title and is borne by Colonel The Honourable William Francis Forbes-Sempill, only son of the 18th Baron Sempill.

I bring this to your notice not in any spirit of derision, but rather as an item of interest to you, as I have been for some time past an interested reader of the Scientific American.

I may say that as I am a Scot, I read it in the local free public library.

Yours faithfully,
James Watt,
Portsmouth, England.

"Toonerville"

Somebody in Wales, North Dakota has not been "playing the game." As most of us know, an electric flatiron consumes very considerably more current than, for example, an electric lamp. It would appear that some citizen of that otherwise peaceful Dakota community (not listed as incorporated—Census of 1920), unmindful of civic duty, has been using one of these power-greedy domestic aids in excess of the three-horsepower capacity of the town dynamo to supply "juice." Here is a fine state of communal anarchy!

Yet the diplomatists of the Electric Light Association of Wales were equal to the occasion. Here is what, according to a clipping sent in by one of our readers, they wrote their several patrons:

Regarding electric power on Tuesdays—the plant will only put out 20 amperes. An iron pulls about five amperes and a motor for washing about two amperes. The plant will thus handle only four irons at one time. There are eight who have them and the four to use it in the morning are Mrs. George H. Johnson, Mrs. George Lachner, Mrs. Jo Levin and Mrs. Platz. The other four in the afternoon are Mrs. Fischer, Mrs. Fraser, Mrs. Nelson and Mrs. Wareburg. If any others want to use power at this time they will have to see the engineer.

It is for your own good to observe these rules. If more go on than the plant will handle you will not get the power you want, and besides, you will hurt the engine by overloading.

Who's to Blame for Road Corrugation?

This reader believes that the automobile is not guilty, in spite of what the United States Bureau of Public Roads has to say about it. It is his honest conviction that the metal blades used in scraping and repairing roads are the cause of all the trouble. Do you agree with him?

Editor, Scientific American,
Dear Sir:

In the Scientific American Digest for the current month I note with interest that a research is being conducted to fix the responsibility of that abomination of the public highway, the "washboard" or corrugated surface.

I drive considerably over all kinds of roads throughout the western states from Kansas to California and have found the effect of corrugated roads on my light car not only disconcerting and nerve-racking but dangerous to a high degree. A little loose gravel superimposed on a corrugated surface imposes a skidding effect to a light car and I have twice been shot off the road where only the lucky circumstance of low embankments has saved me from disaster. Hence my interest in the discovery of the criminal guilty of assault and battery on the public highway.

With all due respect to the United States Bureau of Public Roads, however, I very much doubt the possibility of fixing the crime on the automobile, the tires or any other part thereof, with the multitudinous variation in their vibrations and consequent erratic pounding of the road surface. Were these the causes why should not all roads be corrugated and not just "some" roads, as the heading to your article sets forth.

I have settled this problem in my own conviction unscientifically, no doubt, but to my entire satisfaction. Whether I am right or wrong in my deductions I leave others to judge and, as a possible contribution to the abatement of a menace and nuisance to the motoring public, I beg to submit my theory and the proofs thereof.

In my travels about the country I have noticed that wherever the worst corrugations occurred there was used invariably in road repairing a wide steel scraper, with a curved blade actuated to bring greater or less pressure on the road surface as it was hauled along.

(Continued on page 236)

In parts where there was less corrugation, or none at all, the grading was done by rolling or by heavy, harrow-like drag, its beams bearing heavy steel edges; which led me to the only natural conclusion possible. In support of this inference I submit that I know a number of roads in Mexico, leading to important mining camps, that are submitted to a constant traffic of automobiles, both passenger and truck, that have not a sign of corrugation and which—though bad enough in parts and at times—are never repaired unless they become impassable and then by hand—no scrapers.

If circumstantial evidence is admissible I might advance the Bertillon system of fingerprints or handwriting in support of my theory.

Try eating an apple by scraping the flesh with the blunt point of a case-knife, even as our grandmothers used to do in the toothless age, and, unless you go carefully and lightly, you will soon develope a corrugated surface the hummocks or ridges of which will be spaced with almost mathematical precision. Or take a light garden hoe and try scraping the hard, smooth surface of a clay soil. You will not only develop corrugations but the harder you bear down the deeper they will become.

I believe that road corrugations are caused by the natural vibrations of metal blades used in scraping and nothing else.

And so, in pleading "not guilty" in behalf of the automobile, the defense rests.

Very truly yours,
R. L. O'Neill,
Nogales, Arizona.

New Light on Boy Scouts

It generally has been agreed even by boy scout officials that the boy scout movement originated in England and that the American organization was patterned after its British cousin. Now, however, evidence is pouring into the Scientific American offices, as a result of Milton Wright's article on "Budding Scientists," tending to show that the boy scouts originated in this country.

It sounds reasonable. The general plan is characteristically American, the woodcraft and other lore is distinctly American, and even the terminology is more American than English. To this internal evidence, however, we add the two letters below, one from S. Keith Evans, and one addressed by Daniel Carter Beard, "father of the Boy Scouts of America" to Mr. Evans.

Editor, Scientific American.

I think you may be glad to have called to your attention an inaccuracy which appears in the June issue of Scientific American, on page 382 in an article entitled "Budding Scientists" by Milton Wright.

A picture of Dan Beard is inserted at the bottom of the page, and it says that he was the founder of the boy scouts in 1910.

Actually, the foundation of the boy scout movement the world over was an organization of boys under the name of the Sons of Daniel Boone, which was originated and carried on by Dan Beard for a number of years prior to 1906.

The Sons of Daniel Boone was originally a department in the old *Recreation Magazine*. This department was taken over by the *Woman's Home Companion* in 1906. I think it was about that time or a little later that General Baden-Powell started the same movement in England modeled on the Sons of Daniel Boone, but gave it the name of the "Boy Scouts," because Daniel Boone was not known among the boys in England, and while it is correct to say that the boy scout movement was founded by Dan Beard, the date of 1910 is about six years out of the way.

Sincerely yours,
(Signed) S. Keith Evans.

Mr. S. Keith Evans,
247 Park Avenue,
New York City.

My dear Colonel Evans:

The Boy Scouts of the Sons of Daniel Boone were organized in 1905. Each individual was called a "scout" or a "tenderfoot." You will find in the *Woman's Home Companion* that Baden-Powell himself in writing for the Society spoke of them as "scouts" and of their work as "scouting." This is also in your old magazine. In 1907 at the suggestion of your editor, Mr. Arthur Vance, I made an appointment with the President of the United States and went to Washington, was received alone in the Cabinet room where I had a personal interview with President Roosevelt and he not only endorsed the scout idea then and there, but he sent me to Major General Bell and Admiral Dewey and they both endorsed the idea, having been requested to do so by the President. All of them gave their names to badges of heroism and merit badges which are the grandfathers of the merit badges now used in the boy scouts.

I wish you would write to General Milton Davis, New York Military Academy, Cornwall-on-Hudson, New York, and get his account of my visit to Major General Bell. He was there at the time and remembers the details much better than I do, and I would like to have his statement in writing. You can ask it of him better than I can because you are a disinterested party looking up historical data connected with your own work and your own magazine. I have heard General Davis tell of our meeting there in a most interesting manner. Get him to dictate it while this information can be gotten together. Dewey is dead, Bell is dead, Roosevelt is dead, but Davis is with us.

Hastily and affectionately yours,
(Signed) Dan Beard.

Organize a Club in Your Home Town

Enthusiastic amateur telescope makers from a number of cities have written us to inquire for the names of other enthusiasts living in the same communities, and with the list given, have organized local telescope clubs. Here is a typical letter from one of these organizers:

Editor, Scientific American:

Your sending me the names has allowed me to get them together, and we have had meetings with much mutual help. We are thinking of associating as the "Rocky Mountain Amateur Telescope Maker's Club." We are all progressing fairly well with our telescopes at different stages, some still grinding, others polishing. We have patterns nearly completed for castings in brass for mountings similar to the "Springfield Mounting." There is one real mechanic, Mr. Haberl, who is much help to us, while some seem to excel in theory. Thus we hope to obtain excellent results by reason of our association.

H. A. Davis.

An Old-timer Returns

In communicating with us regarding a subscription, Mr. Foran sends us the bouquet that is reprinted below. We wish to thank him for it and hope that the opinion which he formed years ago will be borne out by all forthcoming issues of the Scientific American. We will do all in our power to make this a fact.

Editor, Scientific American:

I am prepaying postage on so much usable writing space that I am tempted to use it for telling you that I made the acquaintance of your magazine a very long time ago, but lost sight of it in the turmoil of a life that touched science somewhat eccentrically.

I came across it again a couple of years ago to find my youthful impressions of your periodical well confirmed. What I admire about the Scientific American is the intensely interesting and enlightening way in which it treats all its subjects. No pains appear to be spared to make the most abstruse subject comprehensible by an average mind. It is really a godsend to find that when—under the proper stimulus—the scientist can be induced to descend from the rigorous heights where his lofty thoughts are usually evolved, he can charm so supremely the man of common understanding.

Robert Foran,
Dublin, Ireland.

Commercial Property News

A Department of Facts and Notes of Interest to Patentees and Owners of Trademark Rights

Conducted by Milton Wright

Don'ts for Inventors

MANY an inventor uses his employer's time and facilities to perfect an invention on his own account. There are several objections to such a practice. It is dishonest. It also is unsafe. Your employer, finding that you are stealing the time for which he pays you, is likely to divorce you from your job and from the facilities for study and experiment which you need. If you are not hired to be an inventor, and if there is no agreement that your inventions belong to your employer, you, and you alone, are entitled to a patent on what you invent. But it is far better to get your knowledge, your experience and even your ideas in the place where you are employed and then work out the invention in your own spare time. *Don't use your employer's time and facilities to make an invention on your own account.* Should you do so, and the invention be even remotely within the scope of your employer's business, he would have a shopright or license to continue the use of the invention.

That Famous Irish Lace

AMERICAN firms have been importing lace from China, the Federal Trade Commission finds, selling it to manufacturers of garments to be used for trimming, and calling it "Irish Lace," "Irish Crochet," "Chinese, Irish and Filet Laces" and "Chinese and Irish Crochet." The manufacturers have been advertising the finished garment as "Trimmed with Irish Lace."

Against one such firm, Bardwil Brothers, the Commission has issued the following restraining order:

"It is ordered that the respondents, Ameen Bardwil and George Bardwil, individually and as partners trading under the firm name and style of Bardwil Brothers, the agents, employees and servants of them, and each of them, cease and desist from selling or offering for sale in commerce among the various States of the United States, as and for Irish lace or Irish crochet, lace made in China or elsewhere than in Ireland, and from applying thereto or using in connection therewith, or as descriptive thereof, the word 'Chinese' or any other geographical designation in conjunction or association with the word 'Irish,' or any other name, or other word, suggestive of Ireland as its place of manufacture."

Made in France

"BETSY ROSS, we are here," is a statement now in order for some Frenchman to make.

American flags, it seems, have been imported in large quantities from France recently, a fact which might not have been called to public attention, had not the importers failed to comply with the law requiring that imported goods be stamped with the name of the country of origin. Three consignments recently were held up at the Customs House at New York.

The importers protested that the flags cannot be marked, stamped, branded or labeled without injury. Judge Adamson, of the Board of General Appraisers, however, ruled that they must be, and that the Collector of Customs was justified in imposing an additional duty of 10 percent *ad valorem* because they were not legally marked.

Hereafter, therefore, do not be surprised to see on an American flag the label: "Made in France."

Patents Recently Issued

Classified Advertising

Advertisements in this section listed under proper classifications, rate 25c per word each insertion; minimum number of words per insertion 24, maximum 60. Payments must accompany each insertion.

Official copies of any patents listed in this section at 15c each; state patent number to insure receipt of desired patent copy.

Pertaining to Apparel

GARMENT.—In the form of a "slip" which will be more graceful, especially on stout figures, and will better accommodate a sitting posture. Patent 1586268. Sally C. Reed, 861 Sutter Ave., San Francisco, Calif.

PRINCESS SLIP.—Which will fit the figure snugly, especially across the chest and back, and be readily adjustable to different sized figures. Patent 1588357. A. Gulitz, 543 W. 146th St., New York, N. Y.

HEADDRESS.—Adapted for persons having bobbed hair, a comb being so constructed that suitable ornaments or a cap may be associated therewith. Patent 1589185. R. W. Lithgow, c/o Los Angeles Country Club, Beverly Hills, Calif.

Electrical Devices

TELEPHONE-RECEIVER PROTECTOR. — Comprising a cup-shaped member formed of paper, to be placed over the receiver for preventing the transmission of contagious diseases. Patent 1589130. J. A. Dominguez, c/o J. A. Dominguez & Son, Mayaguez, Porto Rico.

TELEPHONE ATTACHMENT.—For preventing fraudulent or lightweight coins from operating the signal gongs of pay-station telephones. Patent 1587460. J. E. Wyckoff, c/o Rochester Telephone Corp., Rochester, N. Y.

COUPLER FOR RADIO.—Which in its operation permits finer tuning and more stable operation, and reduces the cost. Patent 1587381. A. P. Hinsky, c/o E. A. Weeks, 8428 114th St., Richmond Hill, N. Y.

PIANO LAMP.—Particularly designed for detachable association with the cross rail of grand pianos and extending forward of the music rack. Patent 1587388. J. Lieberman, 39 W. 22d St., Bayonne, N. J.

CONDENSER.—Wherein one set of rotors enters the stator plates while the other leaves, with means for adjusting either of both rotors. Patent 1587389. O. G. Lissen, 151 Highland Ave., Jersey City, N. J.

SWITCH-THROWING DEVICE.—An arrangement of electromagnets and levers especially designed for use in connection with toy railroads, or railroads of any type. Patent 1588366. H. A. Heyne, 8980 213th St., Queens Village, L. I., N. Y.

ELECTRODE CONSTRUCTION.—For lighting and heating purposes whereby the electrodes burn more uniformly and the arc requires no controlling mechanism. Patent 1590088. E. Dobrowsky, 168 W. 96th St., New York, N. Y.

STORAGE BATTERY.—With means for sealing the battery against loss of fluid at points where the terminals project, for use on automobiles. Patent 1588959. E. Gregg, c/o L. S. Robson, Claremore, Okla.

STORAGE BATTERY CONSTRUCTION.—Which will prevent corroding of positive terminals, the breaking of jars, leaking of the electrolyte, and the soaking of the wood case. Patent 1588502. A. M. Small, 2501 Central Ave., Middletown, Ohio.

Of Interest to Farmers

THINNING OUT AND WEEDING MACHINE.—Wherein a number of blades give clean cuts through the earth, and vegetables or weeds, so that the action will also cultivate. Patent 1588309. A. Christensen and A. W. Warsen, c/o A. W. Warsen, 50 Ashford St., Hartford, Conn.

TRACTOR AND GUIDE.—Whereby the plow may be shifted easily in a transverse direction to the direction of the tractor movement. Patent 1588273. G. H. Scanlan, c/o J. A. Sheehan, 44 Court St., Brooklyn, N. Y.

SOIL SCREEN FOR PLOWS.—An attachment upon which the furrows can be turned directly, resulting in the separation of weeds, etc., from the soil. Patent 1590035. J. Kemp, Box 36, Dahles, N. D.

COMBINATION MIDDLEBREAKER AND CULTIVATOR ATTACHMENT FOR PLANTERS OR FERTILIZER DISTRIBUTORS.—Which can be attached to and removed from the side bars of an ordinary planter without special tools. Patent 1588400. J. B. Drew, Hollandale, Mississippi.

PNEUMATIC DRAFT GEAR FOR THE CULTIVATING TINES OF STUMP JUMP AGRICULTURAL IMPLEMENTS.—Giving an easier adjustment of the pressure on the tines to meet varying conditions of ground or tilling requirements. Patent 1589115. W. A. Coombs, c/o Collison & Co., 483 Collins St., Melbourne, Australia.

Of General Interest

CATAPULT.—For the projection of arrows and similar projectiles, whereby the full impelling force can be utilized and accurate aiming facilitated. Patent 1581626. W. L. Barth, 816 Woodlawn Ave., Venice, Cal.

EXTENSIBLE MAST AND SUPPORTING MEANS THEREFOR. — Durable and light weight, may be secured to a gable roof to act as a support for radio antenna or the like. Patent 1581325. R. J. Sands, 288 Oak Knoll Ave., Pasadena, Cal.

MEANS FOR FORMING SEPTIC TANKS.—Whereby the walls of tanks of different sizes and shapes may be accurately formed from material in a plastic state. Patent 1582271. J. Johnson, 203 E. Buffalo, Tampa, Fla.

STEAM TRAP.—For the purpose of automatically effecting the removal of condensate or the water of condensation from steam systems. Patent 1582750. W. H. Hodgkiss, 154 Oxford St., Brooklyn, N. Y.

BURGLAR ALARM.—A spring actuated cartridge firing bolt, applicable to doors or windows, the cartridge being fired on the opening of the door or window. Patent 1583370. F. A. Reece and L. T. Coventry, 2222 Railroad Ave., Aberdeen, Wash.

TOOTH CLEANER.—For effectively removing foreign substances from the crevices, at the same time polishing and cleaning the teeth. Patent 1581501. A. E. Wright, 506 Almer Road, Burlingame, Calif.

PALM GRIP.—A device to be worn on the hand by handlers of sacks and similar containers of grain. Patent 1583606. W. H. Roussel, 152 Clay St., San Francisco, Calif.

SLIP CONSTRUCTION.—Whereby boats may be warped into the slip without causing any damage to the walls of the slip. Patent 1583638. Y. O. Zadigian, 408 Hudson Ave., West New York, N. J.

COLLAPSIBLE SLED.—Including a plurality of longitudinal telescopic sections, which admits of materially reducing the sled length. Patent 1583693. E. Krafft, 213 E. 60th St., New York, N. Y.

GATE.—Normally closed, yet may be actuated by the weight of an approaching vehicle or traveler to open position. Patent 1583869. F. H. Boyer, Box 127, De Quincy, La.

FISH LURE.—Which will spin in the water without any "churning" action, par-

Uncle Sam's Patent Rights

THE House of Representatives' Committee of Inquiry into the operations of the United States Air Services found it necessary to study the question of patents. Here is what they reported:

"There are many instances in which it is necessary or desirable that the Government acquire the use or ownership of patents for aircraft or other requirements. The Government is frequently charged with the infringement of patent rights by owners. The Government may acquire a patent or the right to use it by purchase or by appropriation.

"In practice, the methods of acquiring patents, both by purchase and appropriation, do not appear satisfactory, either from the standpoint of the Government or the patentees. If the Government infringes or appropriates a patent, the only recourse of its owner is to prosecute a suit in the Court of Claims. The expense and delay of such a proceeding frequently amounts to a substantial denial of the rights of the patentee."

Trademarks and Health Authorities

IN Havana, the Department of Health has established a special bureau under the supervision of Colonel Doctor Muxo for investigating dealers who falsely label products of real or pretended foreign origin. Where evidence warrants it, police raids are made.

In the first police raid, a large variety of commodities was seized, among them being a patent medicine for rheumatism, said to be made in New York, canned pears marked "Zoila," purporting to come from San Francisco, and canned asparagus, also said to come from San Francisco.

The campaign will be prosecuted vigorously. While the majority of the fake products thus far seized are medicines, foods and liquors of pretended Spanish and French origin, many of the items are represented as imported from the United States.

American Label Men Score

THE recent decision of the United States Customs Court upholding the collector's assessment of duty at the rate of 60 percent *ad valorem* on woven labels imported by the Pitts and Kitts Manufacturing Company, as manufacturers of silk, is a distinct victory for American label makers. The decision was made over the importers' protest that they should have been taxed at only 55 percent as silk fabrics with fast edges.

Woven labels, such as are affixed to clothing, are made in large pieces and then cut. Label men in this country do a business of about $6,000,000 annually. Their expenses are somewhat heavy, with weavers being paid from 40 to 60 dollars a week on a piecework basis. In European countries similar workers receive less than 9 dollars a week. Consequently, when German firms solicited orders all over this country some time ago, American label makers went into a fight that threatened their very existence.

Another victory, not mentioned in the decision, is that having to do with the provision of the law which requires that imported labels be marked to show the country of origin. The ruling first was made that only the container of the labels be marked with the country in which the labels were manufactured. The American label manufacturers contended that woven labels should be treated the same as cigar labels, namely, that each individual label state the country of origin. They won their point on appeal.

The American label manufacturers are not freed of foreign competition yet, but these two victories help.

ticularly attractive, and not likely to get out of order. Patent 1584100. F. L. Koepke, Box 18, Ridgefield, Wash.

MOSQUITO NET.—Which without discomfort will fully protect the head, face and neck, or may be partially opened to expose the eyes and mouth. Patent 1583872. D. W. Davis, c/o G. D. Anderson, Keith Bldg., Beaumont, Texas.

INDEXING DEVICE.—Whereby a card may be picked out of a series, by the initials of the given and middle names. Patent 1584,238. A. Menger, 611 Adams St., San Antonio, Texas.

FOUNTAIN SHOE-POLISH DAUBER.—Adapted to be used to apply polish to a shoe without causing the hands of the user to be soiled. Patent 1584506. R. Lapierre, Whipple, Arizona.

MEANS FOR TEACHING READING.—By inculcating the association of the first letter of the name of an object and a graphic representation of the object itself. Patent 1584,627. R. T. Marino, Carrera 4a, No. 140, Bogota, Colombia.

SPRING SEAT.—Having a frame in which the forward portion is adapted to move more readily than the rear portion, thus evenly distributing the weight. Patent 1584577. A. Weickman, 218 Harrison Ave., Harrison, N. Y.

DINNER PAIL.—Wherein different articles of food may be stored, maintained at a warm temperature, and the contamination of the food prevented in transport. Patent 1582,338. J. P. Lopez and W. L. Ward, 1720 Bellevue Ave., Los Angeles, Calif.

SUPPORT FOR WORK-MAGNIFYING LENSES.—For working on fine objects, where both hands of the operator are required, and the use of a magnifying lens is necessary. Patent 1584519. A. M. Dritz, 258 5th Ave., New York, N. Y.

COMBINATION FORK AND TRAY.—Which allows a complete pre-arranged layer of eggs, to be lifted as a unit and transferred to a processing machine. Patent 1582337. A. E. Lindstrom, 184 6th St., San Francisco, Calif.

INCUBATOR.—In which pure heated air is automatically kept in circulation through the sections containing the eggs, and the foul air expelled. Patent 1584154. H. H. Treffer, 119½ E. 2nd St., Davenport, Iowa.

WINDOW BOX.—Adapted to hold foods, and arranged to be disposed against a lower sash, and that fresh air may circulate through the box. Patent 1585592. M. J. McArthur, 519 Tucerne Ave., Lake Worth, Fla.

TABLE.—Of the folding type, with simple and quickly adjustable bracing means for holding the supporting members in rigid position. Patent 1585508. C. N. Miner, Concord, Mass.

SANITARY CABINET.—Having means for movably supporting a receptacle, from which lard or any other substance may be dispensed. Patent 1585574. J. H. Thompson and J. W. Carter, c/o J. W. Holman, Fayetteville, Tenn.

COMFORT CHAIR FOR CHILDREN AND INVALIDS.—Having independently adjustable back and seat portions, easily manipulated according to the growth of the child or condition of the invalid. Patent 1585545. R. Ingham, 8 Hopkins St., Nashua, N. H.

PISTON ACTUATOR FOR GREASE COMPRESSORS.—Wherein an adjustable tension device is provided acting to cause the continuous pressure of grease, thereby eliminating all air bubbles. Patent 1585538. G. W. DeLoach, 99 South Robert Blvd., Dayton, Ohio.

FISH NET.—Having a plurality of pockets so constructed that they permit entry but prevent the escape of the fish. Patent 1585483. C. K. Freer, c/o Hotel Myers, Janesville, Wis.

EMBEDDED INKSTAND.—For carrying removable ink wells and supporting pencils and other articles below the surface of the desk. Patent 1585029. W. T. Guth, 149 Van Dyke St., Brooklyn, N. Y.

TOILET ARTICLE.—Comprising a mirror, a comb and case, and a spring clip for releasably supporting the comb and mirror. Patent 1584858. E. Hodaly, Inspiration, Arizona.

BOOKMARK AND LEAF CLAMP.—Intended to hold the pages of a book from turning over, while the book is open to a desired page. Patent 1585037. M. J. Kasian, 4250 N. Keeler Ave., Chicago, Ill.

MULTIFOCAL GLASSES.—So constructed that any one of a plurality of lenses may be brought into position, by the manipulation of a single element. Patent 1585489. H. V. Hailman, Box 509, Hartshorn, Okla.

TOOTHBRUSH COVER DEVICE.—Whereby the brush can be carried in a suitcase in proximity to other articles without any moisture damaging such articles. Patent 1586488. R. E. Tollner, 723 W. 14th St., New York, N. Y.

FULCRUM DEVICE FOR EARTHWORKING IMPLEMENTS.—Adapted to be attached to the leg and provide a fulcrum for manually rocking the handle shank of a shovel or fork. Patent 1583181. S. Rubio, 920 Sunset Blvd., Los Angeles, Calif.

SUPPORT SERVING AS CORE FOR BEADS DURING THEIR MANUFACTURE.—Comprising a thin copper tube, and a solid wire disposed within, the wire being removable from the beads, and the tube easily dissolved. Patent 1586462. J. Paisseau, c/o C. Bletry, 2 Boulevard de Strasbourg, Paris, France.

NAIL FILE.—The cutting portion of which stops in front of a smooth edge, so that the skin next the nail will not be injured. Patent 1586441. J. A. Blom, S. W. 48, Wilhelmstrasse 8, Berlin, Germany.

BASEBOARD AND SHOE MOLD.—With beveled surfaces, which form a tight joint, taking from the room only the space formerly occupied by the baseboard. Patent 1585,960. I. A. Baum, c/o Stickley & Fitzhugh, 1010 Fidelity Bldg., Memphis, Tenn.

MOISTUREPROOF SCRIBABLE SHEET, TAG AND THE LIKE.—Formed with a base of a given material, and covered with a substance readily penetrated with a stylus. Patent 1586433. C. T. Wittstein, Warren and Arch Sts., Newark, N. J.

BAG AND HARNESS THEREFOR.—Especially adapted for use by school children and girl and boy scouts, constructed to keep the shoulders, back and head erect. Patent 1586058. R. M. Winfield, Fort Davis, Canal Zone.

NEEDLE THREADER.—By means of which an ordinary sewing needle may be threaded with ease, even by one whose eyesight is poor. Patent 1585883. A. Stephen, 165 W. Ohio St., Chicago, Ill.

CORNER BUILDING BLOCK.—Designed to provide end grooves to facilitate handling and to serve as a passageway for reinforcing elements. Patent 1587482. G. Ey, North 4th St., Woodside, N. Y.

BELT LIFE GUARD.—Easily applied to or removed from a window frame, allowing free movement, yet guarding persons cleaning the outsides of windows. Patent 1587476. G. Digiovanni, 460 E. 171st St., New York, N. Y.

LAMP BASE OR PEDESTAL.—Which includes a skeleton framework and a translucent covering, permitting the matching of the pedestal and lamp shade. Patent 1587469. R. L. Campagna, 1802 Kings Highway, Brooklyn, N. Y.

COATED BUTTER.—In which the coating is unnoticeable, edible, will hold the butter in shape, and prevent it from absorbing odors. Patent 1587414. W. H. Pond, 124 Goodrich St., Astoria, L. I., N. Y.

CIGARETTE CASE.—Which may be inexpensively produced, and is provided with means for projecting the cigarettes for easy removal. Patent 1586248. M. Komura, 1639 Post St., San Francisco, Calif.

MOP HEAD.—Whereby a mop may be secured in such manner as to facilitate the wringing thereof, yet may be easily removed. Patent 1587376. J. H. Gillis, Commerce Hotel, Gainesville, Texas.

FINGER RING.—Which may be quickly adjusted to move a reflecting member to be visible through an opening in the ring's outer wall. Patent 1586606. I. L. Cain, Box 1573, Wichita Falls, Texas.

INDEX.—In the form of a turnable structure, with the indexes disposed about an axis, and capable of being slid laterally outward. Patent 1588299. A. Boucher, 50 Commonwealth Ave., Dedham, Mass.

SERVICE-PIPE BOX AND CUT-OFF.—For the supply of water or gas, constructed with an outer and inner casing effectively sealed, and having coacting means. Patent 1588371. H. S. Isham, 404 10th Ave., Belmar, N. J.

PROCESS OF PRODUCING REPLICAS OF TEXTILE SAMPLES.—By the use of yielding blanks capable of receiving impressions and of being cured or vulcanized to set the impressions. Patent 1588278. B. F. Stez, c/o Munn, Anderson & Munn, Woolworth Bldg., New York, N. Y.

AUTOMATIC FEEDER.—In which stock cannot interfere with the operation of the device, and feed is admitted to the trough, only as required. Patent 1587775. T. J. Higgins, Odell, Ill.

READY-MADE DUMMY TOOTH.—To be used as a bridge between two abutting teeth, and may be readily anchored without the anchoring means being exposed. Patent 1586912. H. E. Murphy, 615 Miner Bldg., Eugene, Oregon.

Hardware and Tools

LOCK NUT.—Made in sections with wedge means to tightly bind the sections on the bolt to prevent displacement. Patent 1585,627. D. O'Brien, Punta San Juan, Cuba.

PERMUTATION LOCK.—Which is absolutely noiseless so that it would be impossible for unauthorized persons to open the combination by sound. Patent 1584834. C. F. Blades, 610 W. 5th St., Topeka, Kansas.

WORK-HOLDING CLAMP.—Having a minimum number of adjustment screws for holding work in numerous positions and at convenient angles to the operator. Patent 1585490. A. S. Hainsworth, Box 5, West Pittsburg, Lawrence County, Pa.

FAUCET.—Of the automatic closing type, operated by pressure, which functions to admit fluid gradually to the nozzle, and will prevent freezing. Patent 1586418. J. Frederiksen and C. Sutherland, Bend, Oregon.

AUTOMATIC AND ADJUSTABLE BURETTE AND FUNNEL HOLDER.—Formed from a single length of spring wire, thereby exposing the reading thereon throughout the full length. Patent 1585959. W. S. Avery, c/o Chas. O. Hill, 1835 Melrose Ave., Knoxville, Tenn.

ATTACHMENT FOR SHOVELS.—Allowing the utmost freedom in manipulating the shovel without necessitating the operator bending over as much as usual. Patent 1586056. A. Q. Walsh, Hartsdale, N. Y.

FELT CUTTING TOOL.—By means of which a washer or gasket of any size or shape may be quickly cut. Patent 1586267. C. J. Rector, Box 545, Monterey, Calif.

KNIFE OR CUTTER.—Wherein the blade is detachably mounted, yet securely held in the handle so as to be reliably safe in operation. Patent 1586906. E. Lewis, 425 So. 16th St., Terre Haute, Ind.

CENTER PUNCH.—For facilitating the operation of definitely locating the central or axial line of machinery shafting or the like. Patent 1586281. G. A. Brunelle, c/o French Hospital, Geary St. and 6th Ave., San Francisco, Calif.

CAN OPENER.—Where both hands of the operator are used to manipulate the blades, bringing more power and greater speed on the operation. Patent 1586264. A. Page, 1700 La Loma Ave., Berkeley, Calif.

RAZOR BLADE KNIFE.—Which will firmly hold a safety razor blade permitting its use as a knife, or for the honing of the blade. Patent 1587358. F. F. Arnold and C. Kestel, 206 E. 19th St., New York, N. Y.

WRENCH.—A self-adjusting wrench which is particularly designed for use in connection with small sizes of bolts or taps. Patent 1587407. J. D. O'Brien, 2 Burling Slip, New York, N. Y.

SYSTEM OF PADLOCKS.—Especially planned for gates in the country, with the purpose of inducing those who pass, leaving the gate shut behind them. Patent 1587432. J. Sirven, c/o G. Breuer, Maipu 671, Buenos Aires, Argentina.

LINE AND SURFACE LEVEL.—Having means whereby it is locked against accidental disengagement on a line, and on the surface gives true results. Patent 1587436. E. A. Stevens, Newton Falls, Ohio.

GUIDE FOR SASH WEIGHTS.—Consisting of metal plates, operable to constrain the weights in a smooth manner and to prevent jamming. Patent 1587218. W. E. De Camp, 420 W. Adams St., Macomb, Ill.

COMBINATION AX AND ADZ.—Having a head adjustable at will, so that the working angle may be varied and firmly secured to the handle. Patent 1587767. J. A. Fatico, 71 Vine St., Willoughby, Ohio.

LOGGING HOOK.—Having an independent latch which is movable into engagement with the ferrule on the free end of the choker. Patent 1587678. W. Remington, 411 Water St., South Bend, Wash.

CLAMP.—For connecting the ends of a belt so that it may be kept taut, without projecting elements contacting with a pulley. Patent 1588369. W. E. Horner, c/o J. H. Bartlett, Atty, Tonkawa, Oklahoma.

SCREW-THREADED JOINT.—Adapted to be utilized for connecting tubular sections or stems used in connection with drilling or maintaining oil wells. Patent 1588128. G. A. Montgomery, Box 625, Titusville, Pa.

SHEARS.—Which will be rugged and durable in use, and will sever the relatively thick stems of a hedge by a clean cut. Patent 1590075. P. Brenner, c/o C. Wagner, 242 Broadway, Monticello, N. Y.

ROTARY REAMER.—Which may be effectively utilized without wrenching or twisting the drill stem, and may be easily withdrawn from a well. Patent 1589508. A. Boynton, c/o Frontier Oil Co., Oil City Natl. Bank Bldg., San Antonio, Texas.

BALANCE LEVEL.—For carpenters and other workers, whereby not only the horizontal and vertical may be ascertained but substantially any angle from a horizontal. Patent 1590136. W. A. Valentine, Sr., 46 New St., East Orange, N. J.

WRENCH.—Having a pair of pivoted jaws substantially in line with the handle, for turning an object in a relatively slight area. Patent 1589206. G. H. Miller, R. F. D. No. 1, Monticello, Maine.

CLOSURE LOCKING DEVICE.—Capable of attachment respectively to a support and a closure, and coacting to prevent the movement of the closure. Patent 1589149. F. L. Hanle, 43 Morgan Place, Kearny, N. J.

GAUGE FOR CUT-OFF SAW BENCHES.—Wherein the gauge elements are automatically shiftable to an inactive or active position when the gauged object is removed. Patent 1589276. F. H. Weeks, 701 E. Market St., Akron, Ohio.

HANGER.—Shaped to be embedded in concrete, for securing pipes or the like to a ceiling, the supporting means being removably associated. Patent 1588628. D. S. Sellers, Jonquin Apt., 2209 E. 10th St., Indianapolis, Ind.

Heating and Lighting

HEATING APPARATUS.—Which combines in one structure the artistic features of the open fireplace, and the utilitarian value of the modern hot air heating plant. Patent 1588587. C. B. Klaus, 3244 W. 64th St., Seattle, Wash.

FIREPLACE.—So constructed that air from the room and outside atmosphere is continuously circulated through the fireplace and heated during transit. Patent 1587227. W. Hallberg, 123½ So. Plymouth St., Los Angeles, Calif.

Machines and Mechanical Devices

BELT SHIFTER.—Having adjustable means for shifting a belt from a fast pulley to a loose one, and for preventing accidental displacement. Patent 1582731. J. B. Chase, 180 Stafford Rd., Tiverton, R. I.

REFRIGERATED BUTTER CUTTING MACHINE.—For cutting uniform blocks or pats of butter from a large bar, and further serves as a means for storing a supply. Patent 1589267. R. Wilson, 341 W. 22nd St., New York, N. Y.

ROLLER IRON.—Whereby the ironing of flat pieces can be quickly accomplished, the entire width of a piece being pressed by a single stroke. Patent 1582379. E. D. Campbell, 675 19th Ave., San Francisco, Calif.

PICTURE EXHIBITOR.—For exhibiting so-called motion pictures and advertisements in daylight, and without the use of artificial light. Patent 1581460. C. H. McCaslin, 388 12th St., Oakland, Calif.

AUTOMATIC ELEVATOR GATE.—Actuated by the ascent and descent of the elevator, the gate opening and closing as the elevator approaches or leaves a floor. Patent 1583,477. W. H. Shafer, 523 14th St., Sacramento, Calif.

FUR-SHEARING MACHINE.—Especially designed for clipping to a uniform length the fur of fur bearing pelts or hides. Patent 1583675. M. Dickerson, c/o Gilroy Hyman, Room 2024, Woolworth Bldg., New York, N. Y.

GOVERNOR.—For the spring motors of talking machines, which reduces the

sibility of breakage to a minimum. Patent 1583640. J. Zitzerman, 449 Stone Ave., Brooklyn, N. Y.

CREAM-WHIPPING DEVICE.—Which is power driven and in which the whipping or beating member may be easily removed without the use of tools. Patent 1584562. C. A. Kulenkampff, 123 White St., New York, N. Y.

DIPPER.—In which the bottom is swingable from closed to open position to allow the body to pass through liquid without disturbance. Patent 1584558. E. Krafft, 213 E. 60th St., New York, N. Y.

SEPARATOR.—With means for removing, by centrifugal force, the particles collected from gases without allowing the escape of the gases. Patent 1584635. W. F. Nagel, 2643 Pike Ave., Ensley, Ala.

SIPHON PUMP.—So constructed that the siphonic flow of a liquid from a receptacle can be broken and renewed at will. Patent 1582399. V. W. Helander, 403 N. Center St., San Pedro, Calif.

MITERING MACHINE.—By means of which a conventional hand saw is supported so that joints of any desired angle may be accurately cut. Patent 1582396. F. Hanemann, 1070b Linden Ave., Glendale, Calif.

FAN.—Of simple and durable construction whereby the blades may be adjusted vertically and secured in adjusted position. Patent 1583864. A. W. Tucker, c/o St. Anthony Hotel, San Antonio, Texas.

KIER SOLUTION CONTROLLER.—Whereby liquid is blown through the cloth in the bottom of the kier, and the solution does not come in contact with the air. Patent 1584491. A. F. Taylor, 425 First St., Kamapolis, N. C.

TIDAL CONDUIT SYSTEM FOR SEWERAGE.—Wherein means are provided for collecting sewerage and then automatically discharging the same into the ocean on an outgoing tide. Patent 1584666. H. G. Shockley, 10 Woodbridge Place, West New Brighton, S. I., N. Y.

WASHING MACHINE.—Which has in combination a chute and safety guard allowing the introduction of cleaning solutions without injury to the operators. Patent 1585,565. J. H. Siemann, 283 11th St., Brooklyn, N. Y.

COMBINED ROAD DRAG AND SCARIFIER.—Which is adjustable, made entirely of metal, and by means of which roads may be surfaced and leveled at a minimum cost. Patent 1585044. W. J. Patton, c/o Central States Steel Co., Frisco Bldg., St. Louis, Mo.

LAUNDRY MACHINE.—Having special mechanism for moving the containers through the rotor, in which the clothes of various families can be washed independently of each other, thus obviating the marking of the clothes, seven of the machines handling the various types of washing done by the standard laundries. The inventor has been granted three patents 1584769; 1584,770, and 1584771. E. L. Hurd, c/o White Swan Laundry, 15 Broadway Circle, Oklahoma City, Oklahoma.

ROTARY DISPLAY RACK.—Which allows a plurality of sheets of wall paper, linoleum, and the like, to be successively displayed by mechanical means, not requiring an operator. Patent 1583158. R. F. Johnson, Wenatchee, Wash.

FUR BRUSHING, STRAIGHTENING AND BEATING MACHINE.—First causing the hair to be straightened out, and finally beaten to raise the hair on the skin. Patent 1586,420. S. Friedman, c/o Reliable Machine Works, 238 Eagle St., Brooklyn, N. Y.

APPARATUS FOR LOADING MATERIAL.—By means of which coal or other material may be continuously discharged into each car of a train. Patent 1585694. F. L. Schoew, 1439 5th Ave., Huntington, W. Va.

NONCOLLAPSIBLE FLOAT FOR LIQUID-LEVEL CONTROLS.—Which may be employed in containers in which a pressure is used which is greater than atmospheric pressure. Patent 1586476. E. E. Simpson, c/o Humphrey & Campbell, Roberts Bldg., Tulsa, Okla.

WAVE MOTOR.—Which affords facilities for making use of the power of incoming waves for operating an air compressor or like mechanism. Patent 1586492. C. Venter, 1928 Lawrence St., Denver, Colo.

PORTABLE COAL TIPPLE.—Whereby the coal is graded at the place where it is mined and directly loaded into the cars utilized for shipment. Patent 1586922. G. C. Singer, Oakland City, Ind.

TIME INDICATING DEVICE.—For determining time with the usual clock dial and hands, by means of an actuating device operable according to the position of the sun. Patent 1587413. J. Pond, Box 100, Summerside, Prince Edward Island, Canada.

PAINT-MIXING MACHINE.—In which the receptacle and the mixing element cooperating therewith are rotated in opposite directions, and secured against displacement. Patent 1588333. A. F. Purner, 523 Hoboken Road, Carlstadt, N. J.

CONNECTING ROD.—For connection with a piston in such manner that a universal connection is established. Patent 1588137. C. A. Myers, 602 Arlington St., Tamaqua, Pa.

DITCHING MACHINE.—Which may be pulled by draft animals or a tractor without requiring the operator's attention in steering the machine. Patent 1586940. J. S. Blackie, Marysville, Calif.

POWER TRANSMISSION DEVICE.—For transmitting power from the rear wheel of a motor vehicle to a shaft, for the actuation of stationary machinery. Patent 1587778. W. H. Kadesch, 1109 Main St., Cedar Falls, Iowa.

COMBINED DOT AND FLAT CLOTH PRINTING MACHINE.—Wherein the flat printing is first performed, and then the dots are placed on the fabric by flocking in any desired succession. Patent 1588318. L. L. De Smet, 250 Van Houton St., Paterson, N. J.

BELT TIGHTENER AND COUPLER.—Which will afford facilities for drawing the ends of a belt together for coupling the same, while trained about pulleys. Patent 1588,368. W. E. Horner, c/o J. H. Bartlett, Atty, Tonkawa, Okla.

ADJUSTABLE STOP FOR LEVERS ON EDGERS.—Of such construction that relative adjustments are readily made to suit the various throws of the operating lever of a saw mill edger. Patent 1589197. J. F. McCarroll, c/o Standard Machine Co., Baton Rouge, La.

Musical Devices

CLARINET.—Having an arrangement of keys and an operating mechanism whereby the fingering is done without shifting the hands when once positioned. Patent 1585,594. J. D. Mackey, c/o Mountain State Engraving Co., 1025 Swan St., Parkersburg, W. Va.

SNARE-WEAR-RELIEVING DEVICE.—For relieving the wear on the skin head of a drum, especially where the snares pass over the edge. Patent 1588324. G. Martens, 3541 35th St., Jackson Heights, Elmhurst, N. Y.

MUSICAL INSTRUMENT.—Having strings so arranged that they will produce normally all the notes of a musical composition in a restrictive zone. Patent 1588636. J. J. Westbrook, Jr., Box 724, Danville, Va.

Prime Movers and Their Accessories

CHARGE FORMING DEVICE.—Designed to make it practicable to use crude oil as a fuel for the engines of conventional types of tractors. Patent 1587423. B. J. Rybin, c/o C. J. Baldwin, Bridger, Mont.

APPARATUS FOR INDICATING THE CYCLES OF INTERNAL-COMBUSTION ENGINES.—For instructing a motorist the various cycles of the different pistons, and the positions of the intake and exhaust valves of an engine. Patent 1589111. A. J. Carr, Box 772, Balboa, Canal Zone.

Railways and Their Accessories

AUTOMATIC RETAINING VALVE FOR AIR BRAKES.—Which permits the air from the cylinder to exhaust slowly, thus keeping the brakes partially applied while the cylinders are recharged with air. Patent 1586891. J. L. Farmer, 1311 Jackson Blvd., Chicago, Ill.

RAIL LUBRICATOR.—By means of which a lubricant may be rapidly applied to a rail and be constantly stirred during the feeding. Patent 1590078. G. Buroz, c/o F. Caracciolo, P. O. Box 55, Caracas, Venezuela.

Pertaining to Recreation

PURSUIT TOY.—Wherein a figure in the form of a policeman is represented as pursuing a second figure in the form of a fugitive. Patent 1588143. J. A. Ross, 147 Prospect St., Nanticoke, Pa.

CHILD'S VEHICLE.—Which may be propelled by the feet, and has a rocking seat operable during the movement of the vehicle. Patent 1587930. P. P. Wetzel, Basic, Waynesboro, Va.

GAME.—Played on a board with marbles, amusing, providing educational value, and developing ability in arithmetic. Patent 1588766. H. N. Massey, 2610 Melvin St., Berkeley, Calif.

Pertaining to Vehicles

AUDIBLE OIL ALARM.—Device for giving an audible alarm when oil pressure in motor drops below a certain fixed point, of simple and sturdy construction with no moving parts. Patent 1582154. Zeiher Bros., Kemmerer, Wyo.

SINGLE FOOT PEDAL FOR AUTOMOBILES.—Which controls the clutch, brake arms, and accelerator, and permits effective control by an operator with a single limb. Patent 1584712. A. L. Bailey and R. R. Gatzke, Box 1010, Butte, Montana.

RADIO CAP.—A closure which can be readily expanded into a funnel, thus functioning as two different devices. Patent 1583153. F. S. Holtz, Box 83, Berkeley, Calif.

ADJUSTABLE PRESSURE FEED AND EQUALIZING CHUCK FOR INFLATING HOSE.—Having means for supplying pressure to a tire up to a certain point, or bringing the pressure down in case of over-inflation. Patent 1584934. W. A. Harris, 238 John St., Greenville, S. C.

LUBRICANT DISTRIBUTOR.—Operable from the driver's seat, for lubricating all the bearings of the chassis simultaneously, proportionate to their individual needs. Patent 1585186. C. C. Crispen, 708 17th St., Harrisburg, Pa.

ENGINE-FLUSHING DEVICE.—For effecting the removal of carbon from the cylinders and valves of motor vehicle engines. Patent 1585025. B. Gorschalki and L. I. Riggin, 870 Morengo Ave., Pasadena, Calif.

NUMBER-PLATE BRACKET.—Which affords facilities for holding releasably, a number plate of any desirable size, and supporting one or more lights. Patent 1586408. C. Champoux, c/o F. G. Kaessmann, Lawrence, Mass.

BLOW-OUT PATCH.—Adapted to co-act with the valve stem of an inner tube and hold the same in proper position on the tire. Patent 1586104. O. A. Morehouse, Cameron, Mo.

LUBRICATING SYSTEM FOR AUTOMOBILES AND OTHER MOTOR CARS.—Having means for lubricating various points from a central reservoir, and means for preventing the exhaustion of the lubricant. Patent 1585719. J. M. Jackson, c/o Rope & Cordage Co., Union Trust Bldg., Parkersburg, W. Va.

DIRIGIBLE HEADLIGHT FOR VEHICLES.—Adapted to automatically turn the headlights in the same direction as the wheels, and is also to swing in vertical plane. Patent 1586945. J. M. Calkins, Box 611, Detroit, Mich.

AUTO LICENSE PLATE HOLDER.—In which the plate may be quickly released, or attached, especially adapted for use by automobile dealers. Patent 1586904. F. Kuhn, P. O. Box 83, Quincy, Ill.

VULCANIZING BLOCK.—For repairs of inner tubes of pneumatic tires, adapted to cause a better flow of the repair gum. Patent 1586275. P. R. C. Winans, 1152 Locust St., Riverside, Calif.

SEAT OPERATED AIR STORAGE AND BRAKE.—For motorcycles, operated by the rider of the vehicle for transmitting the stored air to the brakes. Patent 1584953. R. Learmont, Box 9, Boorowa, New South Wales, Australia.

ANTISKID DEVICE.—Which will permit the ready attachment of a chain to a shoe, and the removal or replacement of a worn tread member. Patent 1587313. S. Hisanosuke, 120 W. 123d St., c/o Japanese Y. M. C. A., New York, N. Y.

VEHICLE BODY.—Having means whereby the body of a motor vehicle may be completely closed when desired. Patent 1587909. J. M. Jackson, c/o Rope & Cordage Co., Union Trust Bldg., Parkersburg, W. Va.

FUEL TANK.—For conserving a definite quantity of fuel, and means for warning the operator as the supply decreases. Patent 1588124. P. A. May, 616 4th Ave. East, Apt. E, Cedar Rapids, Iowa.

ADJUSTABLE-PRESSURE AIR-SERVICE APPARATUS.—For the power inflation of pneumatic tires, which will be continuously efficient and accurate with both low and high pressure. Patent 1588107. W. A. Harris, c/o G. & H. Tire Chuck Gauge Co., Greenville, S. C.

WAGON CONSTRUCTION.—Having novel means for connecting with the king bolt, and for securely and rigidly fastening the hounds thereto. Patent 1588323. F. A. MacNab, Granby, Colo.

DISK CLUTCH.—For use in a clutch of the multiple disk type, admitting a very strong ventilation, resulting in better dissipation of the heat. Patent 1588305. E. Buisson, c/o C. Bletry, Ainé, 2 Boulevard de Strasbourg, Paris, France.

AIR-PRESSURE GAUGE.—For the valve stem used in connection with an automobile tire, applicable to and forming part of the valve stem. Patent 1588285. E. G. Weaver, 110 So. Idaho St., Butte, Mont.

CLUTCH FOR TRACTORS.—Wherein the parts may be actuated for turning the tractor without injury to themselves or any part of the structure. Patent 1588272. G. H. Scanlan, c/o J. A. Sheehan, 44 Court St., Brooklyn, N. Y.

COLLOCATING GAUGE.—Adapted to be bolted on the fly wheel of a Ford engine, to engage the field coils for predeterminately positioning said coils. Patent 1588101. R. A. Farnam, Box 908, La Grande, Ore.

AIR-PRESSURE GUIDE.—Forming part of the valve stem of an automobile tire valve, and for indicating at all times the pressure. Patent 1590141. E. G. Weaver, 621 N. Main St., Butte, Mont.

AUTOMOBILE.—Having a combined running gear and steering mechanism in which a differential is replaced by clutches for connecting the rear wheels to the power driven axle. Patent 1589393. O. L. Howe, 240 Blaine St., Missoula, Mont.

END GATE.—For wagons, trucks, and the like, providing a grain-tight closure for the rear of the wagon box. Patent 1588493. C. Polson, Vermillion, Kans.

DIRIGIBLE LAMP.—Which eliminates all gears and ratchet devices, operates smoothly, is weather proof, and suitable for installation at any point. Patent 1588702. W. A. Cannon, P. O. Box 809 Sanford University, Calif.

VEHICLE TIRE RIM.—Which may be readily collapsed so as to remove it from the tire, the operation being accomplished by a single tool. Patent 1589105. E. Calusinski, 1083 Milwaukee Ave., Chicago, Ill.

COMBINATION VACUUM TANK AND REGISTERING DEVICE.—Allowing gasoline to be fed in measured quantities, so that the operator can at all times tell how much has been used. Patent 1589068. T. T. Givens, R. F. D. No. 4, Box 91, Merced, Calif.

AUTOMOBILE ROAD-MAP ROLL.—Especially designed to be removably secured to the wind shield of a touring car or the frame of a closed car. Patent 1589136. W. D. Fall, 422 So. Spencer, Indianapolis, Ind.

Designs

DESIGN FOR LIGHTING AND FIXTURE BOX.—Patent 70194. M. Schlepp, c/o Sterling Spinning & Stamping Works, 476 Broome St., New York, N. Y.

DESIGN FOR A WEDDING RING.—Patent 70209. J. Berlinger, 106 Fulton St., New York, N. Y.

DESIGN FOR A MEDIUMISTIC BOARD.—Patent 70170. C. Hidalgo and J. L. Zuazua, Garland Bldg., Los Angeles, Calif.

DESIGN FOR A SHOE.—Patent 70267. T. Davis, c/o Franklin Simon & Co., 38th St. and 5th Ave., New York, N. Y.

DESIGN FOR A BACKPLATE FOR LIGHTING FIXTURES.—Patent 70282. B. Leshowitz, c/o Munn, Anderson & Munn, 24 W. 40th St., New York.

DESIGN FOR A COAT.—Patent 70318. T. Davis, c/o Franklin Simon Co., 38th St. and 5th Ave., New York, N. Y.

DESIGN FOR A SHOE.—Patent 70319. T. Davis, c/o Franklin Simon Co., 38th St. and 5th Ave., New York, N. Y.

DESIGN FOR A DOLL.—70315. D. W. Chandler, c/o Annin & Co., 85 5th Ave., New York, N. Y.

DESIGN FOR A SHOE OR SIMILAR ARTICLE.—Patent 70260. T. Davis, c/o Franklin Simon & Co., 38th St. & 5th Ave., New York, N. Y.

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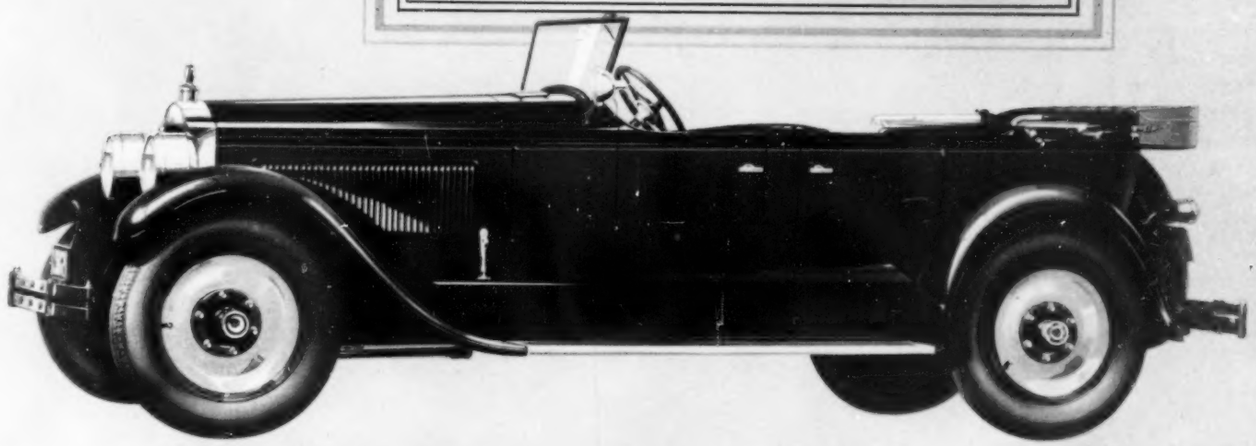

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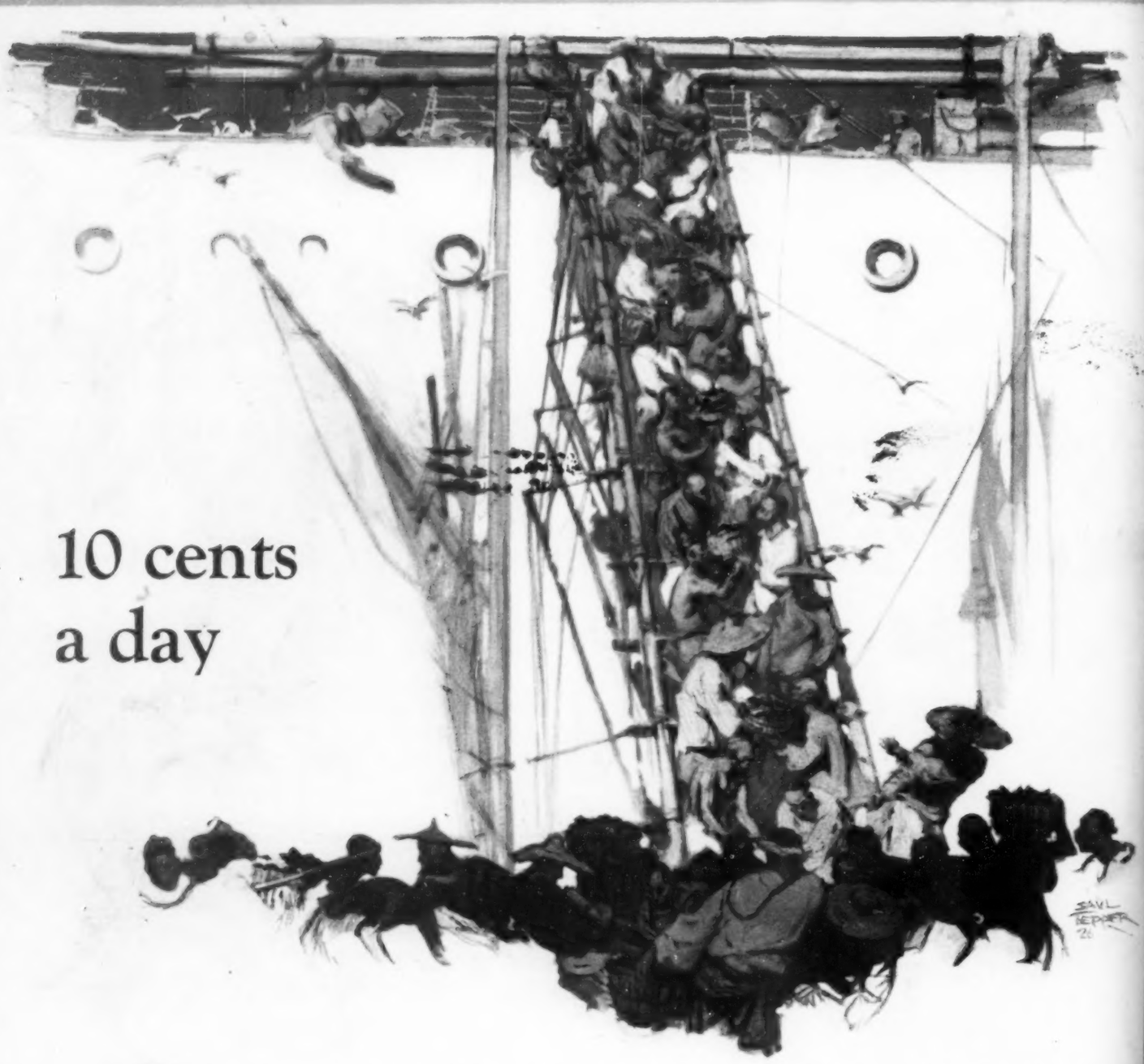

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